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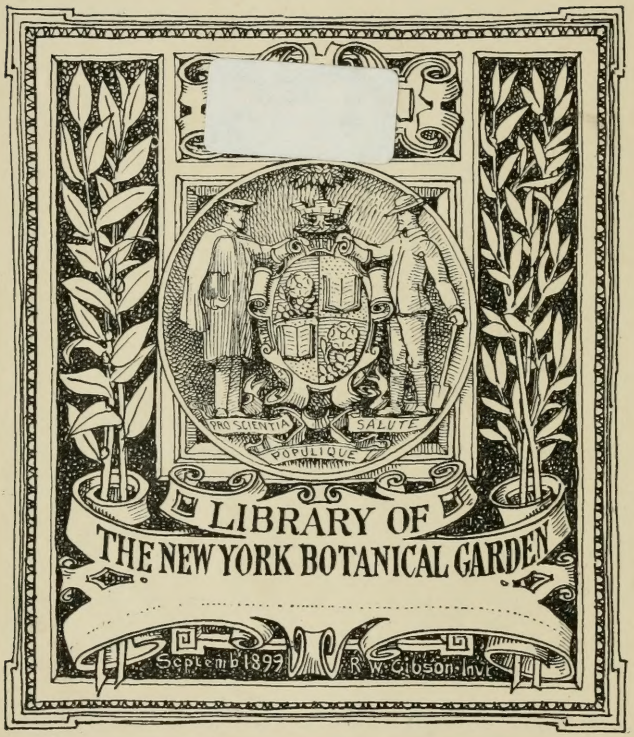
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September 1899
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THIRTY-FIRST ANNUAL REPORT

OF THE

SECRETARY

OF THE

Massachusetts Board of Agriculture,

WITH

RETURNS OF THE FINANCES OF THE AGRICULTURAL SOCIETIES,

FOR

1883.

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STATE BOARD OF AGRICULTURE, 1884.

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His Excellency GEORGE D. ROBINSON.
His Honor OLIVER AMES.
Hon. HENRY B. PEIRCE, *Secretary of the Commonwealth.*
CHARLES A. GOESSMANN, *State Agricultural Chemist.*
JAMES C. GREENOUGH, *President Massachusetts Agricultural College.*

Appointed by the Governor and Council.

	Term expires.
JAMES S. GRINNELL of Greenfield,	1887
JAMES R. NICHOLS of Haverhill,	1885
MARSHALL P. WILDER of Boston,	1886

Chosen by the County Societies.

Amesbury and Salisbury,	J. H. HILL of Amesbury,	1885
Barnstable,	NATHAN EDSON of Barnstable,	1886
Berkshire,	HENRY NOBLE of Pittsfield,	1885
Bristol,	AVERY P. SLADE of Somerset,	1887
Deerfield Valley,	ARTHUR A. SMITH of Coleraine,	1887
Essex,	BENJAMIN P. WARE of Marblehead,	1887
Franklin,	JONATHAN BUDDINGTON of Leyden,	1886
Hampden,	CHAUNCEY A. BUELL of Ludlow,	1885
Hampden East,	WILLIAM R. SESSIONS of Hampden,	1885
Hampshire,	W. L. WARNER of Sunderland,	1886
Hampshire, Franklin & Hampden,	HENRY C. HASKELL of Deerfield,	1885
Highland,	W. S. BOWEN of Peru,	1887
Hingham,	EDMUND HERSEY of Hingham,	1885
Hoosac Valley,	JAMES M. WATERMAN of Williamstown,	1885
Housatonic,	MERRITT I. WHEELER of Great Barrington,	1885
Hillside,	ALVAN BARRUS of Goshen,	1887
Marshfield,	DANIEL E. DAMON of Plymouth,	1885
Martha's Vineyard,	EVERETT A. DAVIS of Tisbury,	1886
Massachusetts,	E. F. BOWDITCH of Framingham,	1885
Middlesex,	JOHN B. MOORE of Concord,	1885
Middlesex North,	A. C VARNUM of Lowell,	1886
Middlesex South,	S. B BIRD of Framingham,	1887
Nantucket,	DANIEL ROUND of Nantucket,	1885
Plymouth,	JOHN LANE of East Bridgewater,	1887
Union,	LEWIS C. NYE of Blandford,	1886
Worcester,	C. L. HARTSHORN of Worcester,	1887
Worcester North,	EDWIN A. GOODRICH of Fitchburg,	1887
Worcester North-West,	J. P. LYNDE of Athol,	1886
Worcester South,	JOHN O. McKINSTRY of Southbridge,	1886
Worcester South-East,	VELOROUS TAFT of West Upton,	1885
Worcester West,	J. HENRY GODDARD of Barre,	1887

JOHN E. RUSSELL,
Secretary

THE

THIRTY-FIRST ANNUAL REPORT

OF THE

SECRETARY

OF THE

BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

The meteorological characteristics of the past year have been similar to those recorded in the thirtieth report, and the results of our husbandry have been very nearly like the experiences of 1882.

The spring weather was favorable, cool, with abundant rains, and grass made an excellent start, developing into a heavy crop. It was secured with good weather.

From this time drouth, the constant accompaniment of our agriculture, set in with a severity exceeding that of the previous season. As no rains fell after haying the mowing stubbles felt the full force of the sun; pastures dried brown; Indian corn, a tropical plant that best withstands dry weather, curled its leaves and on all uplands made a slow and light growth. Early in September, while the ground was the dryest, we suffered sharp frosts which affected the immature corn in every part of the State. Our perplexities were increased by the failure of springs, wells and water-courses. This continued far into the winter. Fortunately our barns were filled with the first crop of hay, corn-fodder was well made, and potatoes proved a fine crop and kept in perfect condition. Root crops proved better than we had feared.

The thirty volumes of our reports are, with several exceptions, a record of drouth. It is almost as certain to come

as the summer. The Massachusetts farmer must prepare to meet it, and so plan his operations as even to turn it to his account.

Drouth is met by the market gardener with methods of irrigation. He drives wells in the light soils that he prefers, and with wind-mills or steam-engines supplies himself with moisture at will; or he forces water from distant springs, ponds or rivers, and makes himself independent of weather.

Some of the large gardeners near Boston use both wind and steam, pumping water continuously. Our field crops cannot be cultivated in this way. Grass must have the early rains, and tilled crops demand the later rains; but the best husbandry is in the bountiful application of manure, for rains alone do not make our crops, nor, if we thoroughly enrich our soil, will drouth destroy them. As the quantity of manure is limited, it follows that it must be concentrated upon fewer acres. We spread over too much land; the plough is idle; our mowings are left year after year until grasses are choked out by weeds, and we have the damaging record of gathering less than a ton of hay to the acre.

The discussions upon the subject of ensilage, three years ago, were of infinite value in convincing us of the real value of corn-stover.

In attempting to make great weight of corn-fodder farmers made the discovery of the actual power of an acre upon which manure and labor are applied in generous measure; they also found the true value of sun-dried corn-stover on which the grain has been ripened. There are now but few herds in the State that are not largely supported upon corn-stover. In time light machinery will be made to shred it and increase the economy of its use.

The tax assessors report an increase of 2,102 horses; a decrease of 3,794 cows, and a decrease of 2,620 sheep. There were 169,879 cows and 62,780 sheep.

The decrease in the number of cows may be attributed, in large part, to the bad condition of the business of supplying milk to Boston. The distribution of the milk is entirely in the hands of men called "contractors," who, at the opening of each season, make a price at which they will take

milk. For some years past this price has been less than the value, and even less than the cost of the milk, but the farmers have acceded to the terms. If the season proves favorable and the pastures are good, the amount produced may exceed the demand for pure milk, of which only from sixty to seventy per cent. is required to make the amount distributed to the consumers; in that case the contractor turns it back upon the farmer.

If the season proves a bad one the farmer gets no more for the lessened supply, so that in either case he is the loser.

By an act of the last legislature the Board of Health, Lunacy and Charity is made the guardian of the public against such frauds as the adulteration of milk, and empowered to appoint inspectors to take samples, analyze milk, and to prosecute fraudulent dealers.

In this work the officers of the Board have been thorough, and their investigations reveal the fact that a very small part of the milk sold in Boston is genuine. It is, for the most part, skimmed, extended with water, re-colored with caramel, and it is often treated with boracic acid that it may be kept in the dealer's possession longer than would be possible if it was in a natural condition.

This fraudulent manipulation is not attributed to the milk-producers, nor to the contractors who collect the product and sell it at wholesale; it is the vice of the retailer who distributes it from house to house.

This systematic adulteration affects the farmers in two ways: it adds about thirty per cent. to the gross supply of milk, thus meeting the demand to that extent; and the fact that milk is so well known to be adulterated has the effect of lessening its free use.

This condition of affairs would seem to indicate a co-operation between producers and consumers, as the proper remedy for an abuse that affects not merely comfort and luxury, but assails the health of children. It is, however, a discouraging fact that the public take little interest in the matter. So long as a fluid that has the appearance of milk is served early at their doors, few ask questions. Many wealthy families who unhesitatingly use a food compounded by unscrupulous peddlers, take pains and are at expense to

procure drinking-water from distant springs, while the water mixed in their children's milk may be supplied from a stable-yard well infected with germs of disease.

With this apathy on the part of the public, farmers must rely upon themselves. No one is compelled to produce milk or to accept a contractor's offer, and a co-operative agreement between the farmers, resolutely adhered to, not to sell their milk below a price satisfactory to themselves, would bring the contractors to their terms. To effect this the farmers must have a thorough organization, and deal with the contractors not singly but through a board of capable officers.

Milk production at low prices is fatal to good husbandry. Farmers should make more crop for sale, keep more swine, sheep and poultry.

Co-operation in all large districts, in manufacturing the milk into butter and cheese whenever there was a surplus, or the price offered was not satisfactory, would, in time, control the middlemen.

Sheep husbandry shows no advance. To encourage it the Massachusetts Society for the Promotion of Agriculture, last summer, imported a hundred thoroughbred ewes of the best families. These, with the rams imported the previous season, were sold to farmers at about fifty per cent. of their cost.

These should be the nucleus of valuable flocks, but there is small hope of it.

Our farmers are unwilling to increase a husbandry that is continually threatened with destruction. Our farms are subject to outrageous trespass, and sheep-keeping must suffer until dogs are put upon the same footing as other domestic animals, and their owners made responsible for them.

Horse-breeding on farms has great encouragement from the help afforded by the Massachusetts Society. The Percheron horses imported in 1882 have met with much favor; all of them are in fine condition and must prove of great value to us.

The fairs of the societies under the control of the Board of Agriculture, were unusually successful last year, owing to continuous fine weather during the month of Septem-

ber. Several of them were more largely attended than ever before in their history. The result is indicated in the financial reports in another part of the volume.

The first full year of the work of the Experiment Station has been of great value, as will be seen by the report of its operations herewith included.

The report has already been spread all over the Commonwealth, in frequent bulletins, issued from the Station as the progress of the work has warranted publication.

The present year's work will be of more importance and upon a much more extended field.

The Institutes have been held by all the societies according to the requirement of the Board; several of them held many more than required, to the great benefit of the public that is interested in agriculture.

The health of cattle, sheep and swine has been good throughout the year, no disease being reported by the Cattle Commissioners.

COUNTRY MEETING AT LOWELL.

PUBLIC MEETING OF THE BOARD, AT LOWELL.

The country meeting of the Board for 1883, was held at Mechanics' Hall, in Lowell, on the 4th, 5th and 6th of December. John B. Moore of Concord, called the meeting to order on Tuesday, Dec. 4, at 11 o'clock, and said:—

Ladies and Gentlemen, — The first matter for you to listen to this morning is an address from A. C. Varnum of Lowell. If you will give your attention, Mr. Varnum will now address you: —

OPENING ADDRESS.

BY A. C. VARNUM.

Mr. Chairman and Gentlemen of the State Board of Agriculture, — It affords me great pleasure to extend to you, in behalf the citizens of Lowell and the surrounding towns, a cordial welcome to this section of the Commonwealth. We consider ourselves most fortunate in securing your presence with us, for the purpose to which you propose to devote the exercises of this meeting. We have long known the importance of your great commission, and appreciate to some extent your influence in bringing about the wonderful changes that have been wrought in scientific agriculture since the organization of your Board, under the laws of this Commonwealth.

For more than thirty years, the State Board of Agriculture, in pursuance of the duty for which it was established, has been making earnest inquiry into the methods and requirements of practical husbandry — ascertaining the adaptation of agricultural products to soil, climate and market;

encouraging the establishment of farmers' clubs, agricultural libraries, and reading-rooms, and disseminating useful information in agriculture by means of lectures and institutes; stimulating agricultural societies to greater activity and usefulness; promoting the general education of farmers in the art of agriculture, in every possible way, that they may realize the dignity and importance which belongs to their calling — "the mother of all arts and sciences" — the most ancient, honorable, and useful of all vocations. It has been said that "the perfection of agriculture as an art implies the obtaining of the greatest amount of product from the earth with the least injury to the land, and at the least cost." To obtain this perfection the learning and wisdom of the chemist is required, to analyze the soil and its products, and give instruction as to the requirements of various soils for the production of particular crops. The cunning mind and hand of the mechanic must be there to invent and construct the labor-saving implements of husbandry; the good sense, good judgment, and practical experience of the farmer, must be exercised in a thousand ways besides turning the furrow and planting the seed.

Before the organization of your Board, in 1852, and long afterwards, you well remember the great prejudice that existed, both in this country and all over the world even, against scientific farming; and the chief obstacle which you have met in your efforts at improvement has undoubtedly been, to use a mild term, conservatism. We naturally cling with great tenacity to old ways — old maxims and old traditions.

Science has had to work its way slowly in all ages and in all countries to overcome prejudices and opposition, especially in its application to agriculture. So simple and so useful an invention as a winnowing-mill was most obstinately opposed by the farmers of Scotland, where it first appeared, and was denounced from the pulpit as a devilish and presumptuous invention of the arch enemy of souls. They preferred the old way that was practised by the Roman laborers long before the Christian era, of pouring their grain from one vessel into another and letting the wind blow the chaff away.

We welcome you to-day, gentlemen of the State Board, and extend our hearty greeting, not only because we are glad

to see you and make the acquaintance of a body of representative men, but because even with the light of the present day, and all the general advance in agriculture, there is still an inclination among many of our farmers to go on in the same old paths which their fathers trod. They are constantly looking back to "the good old days of Adam and Eve," and, like the Israelites of old after they came up out of bondage, they look back and long for the cucumbers and melons, the leeks and the onions of former days. Therefore we feel that your influence will be salutary, and must stimulate us to higher and better things, and more profitable modes of farming.

At the twenty-fifth anniversary of the creation of your Board, Hon. Marshall P. Wilder, who ever since the existence of your organization has been an earnest and interested co-worker with you, in recounting some of the wonderful changes that have transpired in a quarter of a century, said, — "Few are aware of the salutary influence which the Massachusetts Board of Agriculture has exercised on the farming communities and the public mind during the period of its existence. An entire and complete change has taken place in public opinion with regard to the paramount importance of agricultural education. There are some here who remember at the time of the organization of the Board the great prejudice which existed against what was called 'book-farming,' and there were but few papers or periodicals that would stand forth as champions of the cause. Almost an entire revolution has taken place in the received principles and practices of cultivation during the existence of the Board; and much of this can be traced to the investigations of its members and the publication of their experience, thus not only teaching each other, but making the knowledge of one the property of all." Many of us can testify from personal recollection to the truth of this statement.

The farms and farmers of Middlesex County are witnesses as to the importance of science and education as applied to agriculture. All these great changes have been brought about by men of intelligence, inquiry, education, and science, and I am happy to add that Middlesex County, as a whole, has not been backward in appreciating the benefits of advanced husbandry.

In accordance with a custom long since established with the approval of your Board, that the opening address might appropriately contain some account of the leading industries of the county or section of the Commonwealth where the meeting is convened, and this being the first visit of the Board in this vicinity, and many of you strangers here, I will give a brief sketch of our city, with some of the interesting facts connected with Lowell and a few of the other towns embraced within the limits of the Middlesex North Agricultural Society.

Lowell was incorporated in 1826. The territory was taken from the town of Chelmsford, one of the oldest towns in this vicinity, which was incorporated in 1655.

The interval land along the banks of the Merrimack River at this place being free from stone and of excellent quality for agricultural purposes, together with the abundant supply of many valuable varieties of fish, attracted the early settlers to this place; but the territory where Lowell now stands was occupied by the Pawtucket tribe of Indians, and the General Court, at the solicitation of John Eliot and others, passed an Act in 1653, reserving it to their exclusive use.

A ditch was subsequently cut to enclose the Indian territory, traces of which are still visible. It began above Pawtucket Falls and extended in a semi-circular line easterly, ending at the Merrimack River below Hunt's Falls, and enclosed about 2,500 acres.

It is said that the Indians insisted on this ditch or trench as a boundary line, because it could not be easily removed.

The chief of the Pawtucket tribe, soon after Chelmsford became a township, was Wannalancet. In 1669 he came down the Merrimack with his warriors, and built a fortification on what is now called Fort Hill, in Lowell, fearing an attack from the Mohawks. For many years all the Indians in this vicinity made a visit to Pawtucket Falls in the spring to obtain their supply of fish, and John Eliot, who came to Massachusetts in 1631 and was settled as minister over the church at Roxbury, took this opportunity to preach to them. His first sermon here was from Malachi i: 11, which he thus paraphrased, "From the rising of the sun to the going down of the same Thy name shall be great among the Indians.

During King Philip's war, which began in 1675, the Pawtuckets with their chief withdrew to Canada and the fort at Pawtucket Falls was occupied by the white settlers, under command of Maj. Thomas Henchman. This war resulted in destroying no less than thirteen towns and six hundred colonists. The people of Chelmsford, Dracut, Tyngsborough, and all the other towns in this vicinity erected garrison houses, several of which are still standing. There is one in Lowell on land formerly belonging to the town of Dracut, but recently annexed to Lowell, owned by our enterprising townsman Henry Emory. When the war was over these Indians returned to their reservation from Canada, but they had previously sold to various persons small tracts of their land, and in 1686 Col. Tyng and Maj. Henchman purchased all that remained, leaving them only their rights of fishing and hunting. They soon after returned to Canada and joined the St. Francis tribe, and never came back to their old hunting grounds.

It was not until near the close of the last century that anything was done towards making the waters of the Merrimack specially available for the industries of the white race. About this time, however, there was a demand for the wood and timber from the extensive forests along the shores of the Merrimack, and millions of feet of lumber and thousands of cords of wood were rafted down the river; but the descent at Pawtucket Fall was so great, the current so swift and the rocks so dangerous, that it was impossible to pass them with rafts, and great trouble and expense was incurred by teaming this lumber around the rapids. It was finally determined to construct a canal around the falls, and an Act of the General Court was obtained, incorporating Dudley Atkins Tyng, William Combs, Joseph Tyler and others a "body politic and corporate," by the name of the Proprietors of the Locks and Canals on Merrimack River. A canal was accordingly constructed, connecting the Merrimack above the falls with the Concord River below, a distance of a mile and a half, the descent being thirty-two feet, requiring four locks, and costing $50,000.

The same year (1792) Parker Varnum and others were incorporated as the "Proprietors of the Middlesex Merri-

mack River Bridge," which was built entirely of wood, at Pawtucket Falls, and was the first bridge built over Merrimack River.

In 1792 the Proprietors of the Middlesex Canal were incorporated, which ran from that part of Chelmsford (now Lowell) called Middlesex Village to Boston. It was completed in 1804 and cost $700,000.

This was the first canal in the United States that was opened for transportation of passengers and merchandise, and was considered at that time a stupendous work. (The great Erie Canal was not opened till 1825.) The first steamboat from Boston through this canal reached Concord, N. H., in 1819.

This canal was in operation until 1853; but after the Boston & Lowell Railroad began, which was opened in 1835, it began to decline, but during its existence vast quantities of wood and lumber were transported from the upper Merrimack and the lakes to Boston, and before railroad travel began it was considered quite an improvement over stage locomotion for passengers. A small packet boat was propelled by horse-power called the "Governor Sullivan."

In 1801 Moses Hale put in operation a carding mill on River Meadow Brook (afterwards called Hale's Brook), the first of the kind in this county. In 1804 the wooden bridge that had been erected at Pawtucket Falls in 1792, was removed and a more substantial one erected upon stone piers and abutments at an expense of $14,000. It was made free of toll in 1861 and remained in use until 1871, when it was replaced by the present structure, built of iron, costing about $40,000. All these enterprises are mentioned because they were important in forming the nucleus for the establishment of our present city.

The great water power at Pawtucket Falls remained unimproved until 1821, when it attracted the attention of capitalists for manufacturing purposes. The first company (the Merrimack) was incorporated in 1822 and their first cotton goods were produced in 1823. They started with a capital of $600,000; but it has been four times increased, and is now $2,500,000.

In 1826 a little village had grown up, which numbered

about two thousand people when it was made a separate township. It was called Lowell, in memory of Francis Cabot Lowell of Boston, from whose genius and plans the place had been developed.

Mr. Lowell had been previously engaged in cotton manufacture in Waltham and was chiefly instrumental in introducing the power loom there in 1814.

The Waltham system was introduced here by Mr. Lowell, Patrick T. Jackson, Paul Moody and others with whom he was associated.

Mr. Lowell was a son of Hon. John Lowell, a leading member of the Provincial Congress of 1776, an influential member of the Continental Congress, Judge of the Court of Appeals in Admiralty appointed by Congress, and the First Judge of the District Court of Massachusetts, appointed by President Washington.

Francis Cabot Lowell also left a son (John Lowell) who upon his decease left the generous bequest of $240,000, to found the Lowell Institute, at Boston.

In 1836, with a population of over 17,000 inhabitants, the town was incorporated as a city, and continued to increase in wealth and population until 1857, which is remembered as a period of great financial depression. No great improvement was made for about ten years after this time.

The city originally comprised 2,885 acres, an area of about four square miles. In 1834 the village of Belvidere, then a part of Tewksbury, was annexed, which contained 370 acres. In 1851 Centralville, a part of Dracut, was annexed, containing 583 acres. In 1874, 3,507 acres were taken from Chelmsford, Dracut and Tewksbury. In 1879 about 300 acres more were added from Dracut, making the area of the city 7,615 acres, nearly 12 square miles.

Lowell at the present time has about 100 miles of public streets, seven of which are paved with granite blocks. It requires an annual expenditure of more than $100,000 to improve and keep them in repair.

The appropriation for schools in 1883 was $146,558.41; and we have 9,294 pupils.

The water works of the city were opened in 1873, at a cost of $2,223,049.

Libraries.

We have four public libraries, — the City Library, containing 26,000 volumes; the Mechanics' Library, with 14,900 volumes; the Young Men's Christian Association, with 1,000; and the Young Men's Catholic Library Association, with 700 volumes.

Manufacturing.

The total capital employed in our manufacturing establishments is $17,600,000. We have 156 mills, beside appendant buildings. They have 877,000 spindles, 22,527 looms; and they employ 23,272 persons — of which 13,345 are females, and 9,927 males.

These companies manufacture annually 231,936,000 yards of cotton cloth, and about 8,335,000 yards of woollen goods, 3,532,000 yards of carpeting, 350,000 shawls, 13,695,520 pairs of stockings; and they use 70,695,984 lbs. of cotton per annum, 12,270,000 lbs. of clean wool; and there are 97,240,000 yards of cotton cloth dyed and printed.

There are, also, in addition to the above, various miscellaneous manufactures, some of which employ a large capital and many workmen.

In 1880 the capital employed in the United States in manufacturing, exclusive of hosiery and mixed fabrics, which is a low estimate at the present time, was $280,000,000.

There were 10,921,148 spindles, and 230,223 looms.

They use 1,586,481 bales of cotton, and produce 2,268,000,000 yards of cloth, employing 181,688 persons; and pay for wages $43,000,000.

In 1880 the New England States had 80 per cent. of the looms and spindles of the country, and 71 per cent. of the employees.

Massachusetts had 4,465,290 spindles, or more than twice as many as all the country outside of New England (which was 2,114,731).

The manufacturing interests are larger in Lowell than any other town or city in the United States, excepting, possibly, Fall River.

The great Northern Canal in Lowell was completed in

1847. It was constructed by the combined companies in less than eighteen months, at a cost of $500,000; and at that time was the greatest work of the kind in the United States.

Lowell has had many distinguished visitors, but I shall have time to mention only one.

In 1833 Andrew Jackson, President of the United States, visited Lowell, accompanied by Martin Van Buren, Vice-President, and others, members of his cabinet. The hospitalities of the town (for Lowell was not then a city) were extended to the distinguished visitors. An address of welcome was made by Joshua Swan, chairman of the Board of Selectmen, which was responded to by the President. After this public reception they were escorted through the streets (which had been arched and beautifully decorated), by a regiment of militia, a cavalcade of two hundred citizens, six hundred school children, and over two thousand five hundred factory girls, all dressed in white. The procession passed in review before the visitors, while drums were beating, cannon booming, and banners flying. Subsequently the visitors were taken through the Merrimack Company's mills, where they saw the process of making and printing cotton cloth, by these young ladies in their gala attire.

Railroads.

Lowell is 26 miles northerly from Boston, and is connected directly by rail with Boston, Lawrence, Salem, Nashua, Manchester, Concord, and the Boston & Albany Railway at South Framingham. It may well be said: "It is time that counts now. Space is extinguished."

The Boston & Lowell Railroad was opened June 24, 1835, at a cost of $1,800,000. This has often been spoken of as the first railroad in this country; but the Boston & Quincy, built in 1827, was the first to carry freight by horse power.

The first passenger road was the Baltimore & Ohio, opened with horse power for fifteen miles in 1830. Locomotives were first used in 1831 on the Mohawk & Hudson Railroad, and in 1832 on the Baltimore & Ohio and the South Carolina road.

The Boston & Providence, Boston & Worcester and Boston & Lowell, were each opened in 1835.

The Nashua & Lowell was opened October 8, 1838; Lowell & Lawrence, July 1, 1848.

Stony Brook, July 1, 1848; Salem & Lowell, August 1, 1850. (These, with the Concord, N. H., are operated now as the Boston, Lowell & Concord road.) The Framingham & Lowell (leased to the Old Colony) was opened August 22, 1871; the Lowell & Andover, December 1, 1874 (now leased to the Boston & Maine).

Military Record.

The war of the Revolution had closed long before Lowell came into existence; but during the great war of the Rebellion she bore an active and important part.

The Sixth Massachusetts Regiment was the first to enter the field in response to the call of President Lincoln (April 15, 1861) for 75,000 volunteers. The regiment left Lowell on the 16th; on the 19th it was attacked by a mob in Baltimore, and four of its members were killed.

A monument has been erected to the memory of these first martyrs of the Rebellion in a public square in the heart of our city.

Lowell furnished the army and navy, under the various calls for volunteers, more than 5,000 men.

Gov. Bullock tendered to the people of Lowell his tribute of congratulation at the close of the war as follows: —

"While the industry and wealth of other communities have been stimulated by the war, yours, I apprehend, have been checked and depressed. This, however, did not chill the ardor of your patriotism, which rose above every thought of private interest and broke forth in great acts of generous and chivalrous devotion. Since the men of Chelmsford fought at Concord, Lexington and Bunker Hill, no record has borne prouder honors than those which cluster around the brow of the living and over the graves of the dead soldiers of the Queen City of the Merrimack."

The city government of Lowell consists of a mayor, eight aldermen and twenty-four councilmen, elected annually.

The first mayor was Dr. Elisha Bartlett. The present mayor is John J. Donovan, Esq.

The Middlesex North Agricultural Society, whose invitation you have honored in holding this meeting at Lowell, was incorporated in 1855. By the act of incorporation they were authorized to admit members from the towns of Chelmsford, Dracut, Billerica, Tyngsborough, Dunstable, Westford, Tewksbury, Wilmington, Burlington, North Reading, South Reading and Lowell. The first exhibition was held September 19, 1855, at Chelmsford Centre. In 1857 the society purchased of the Boston & Lowell Railroad Company about fifteen acres of land, for $747, and enclosed it with a substantial fence, at a cost of $1,400. A building was soon after erected, and the society have held their exhibitions at their fair grounds since that time. The society is in a flourishing condition, and many of the farmers are greatly interested in its prosperity. During the twenty-eight years of the existence of this society, there has been a great improvement in our agricultural standing. Nearly all the farms and buildings embraced in the Middlesex North, have been so revolutionized that they would scarcely be recognized. The farmers themselves and their families have been revolutionized. Their appearance, their mode of dress and living, their habits and methods are as much changed as their farms. Our principal products are fruit, vegetables and milk for the market, together with butter, pork, beef and grain; stock-raising was long ago abandoned.

We miss the cattle and horses of olden times at our exhibitions, and especially the long town teams of fat, sleek oxen. I will close this address by a quotation from the well-known historian, Rev. Elias Nason of North Billerica, who speaks of our city in the following beautiful and truthful language: —

"In point of scenic aspect the city of Lowell is probably not surpassed by any inland city in America. The configuration of the land is rendered remarkably picturesque by the meeting of four beautiful streams, the Merrimack, Concord and Beaver rivers, and the River-Meadow Brook (or Hale's Brook); and the five eminences which surround and, as so many ramparts, enclose the city.

From the summit of Christian Hill, commanding a view, not only of these streams, the falls in the Merrimac and Concord rivers and the rapidly extending city, but also of the towns in the vicinity and the broad-spreading landscape from Lawrence and Andover, on the one hand, to the Wachusett, the grand Monadnock and the Peterborough Mountains, on the other — the spectator obtains a breadth and beauty of view which well repays the toil of the ascent. Yet how few of our citizens ever take the trouble to enjoy this vision of beauty! A tower of moderate height on Christian Hill would bring the White Hills, the ocean and the city of Boston into view, and its erection is only a question of time. It is interesting to notice that the population of Lowell to-day outnumbers that of Boston in 1830, and that its rate of increase was never greater than at present."

Mr. Varnum's address was admirably illustrated with views of historical scenes, buildings, and portraits of persons, thrown on canvas by means of the stereoscope, which greatly increased the interest and pleasure of the large audience. At the conclusion the chairman said: —

Ladies and Gentlemen, — Meeting here, as we have to-day, in the great manufacturing city of Lowell, it is eminently proper, and I know it will be your pleasure, to listen to its Mayor, and with that view I have the pleasure of introducing to you the Hon. John J. Donovan, Mayor of the city of Lowell.

ADDRESS OF MAYOR DONOVAN.

Mr. President, Ladies and Gentlemen, Members of the State Board of Agriculture, — I greet and bid you welcome to the city which one of our local poets has termed "the Queen City of the Merrimack Valley." I exceedingly regret my inability to discuss agricultural topics from any practical stand-point, for my previous training has not been in this direction; but I fully appreciate the inestimable value that the Board of Agriculture has been to the State and its people, for good fruits are always the legitimate result of well-directed labor. It is only necessary, in order to raise farming from the position of hard manual labor that it now

occupies to its proper sphere, which is that almost of a science, that the agricultural community, as a whole, should be liberally educated, and fully versed in botany and in chemistry.

Mr. Chairman, I will not take up any more of your time, but I will again bid you, and, through you, the State Board of Agriculture, welcome to the city.

Adjourned to two o'clock.

AFTERNOON SESSION.

The meeting was called to order at two o'clock by Hon. James S. Grinnell of Greenfield, who said : —

The hour has arrived to which we adjourned, and at the request of the committee, I am to preside this afternoon. The Board of Agriculture attempts to make these meetings interesting by the selection of gentlemen who can talk to us on subjects in regard to which we are not, perhaps, so thoroughly informed, — men who have become expert in the lines upon which they expect to address you; and on this occasion we have with us a gentleman whose fame is as wide as that of the United States, with whom you are all familiar as a veterinary surgeon of thorough education and of large experience for his years. He comes on here at our request, and by the special permission and desire, also, of Dr. Loring, the Commissioner of Agriculture, whose interests are with us thoroughly; who went from among us to the high position which he now holds, and who has sent to us the Veterinary Surgeon of the Department of Agriculture, who will now address you — Dr. D. E. Salmon.

VETERINARY PROBLEMS OF THE DAY,

BY DR. D. E. SALMON, U. S. DEPARTMENT OF AGRICULTURE.

It has been known to medical observers, as far back as we have authentic record, that in most of the contagious fevers there is but a single attack, after which the subject is proof against that particular virus. Why this is so still remains

an impenetrable mystery. If a man has had one attack of small-pox, he is not only safe from ordinary exposures, but he may, as a rule, risk contact with the worst forms of the disease. If a fowl has had one attack of the disease called fowl cholera, it resists this disease when it is placed in the worst infected flock; it may even be fed with the flesh of birds which have died with the disease, or concentrated virus may be introduced into its tissues, without producing an appreciable effect. The greater part of these diseases are non-recurrent, and inexplicable as this phenomenon may be, it is unquestionable, and has been the basis of some of the most effective measures which have been proposed for the control of these plagues.

The earlier attempts to take advantage of the principle of non-recurrence were crude and full of danger — people were inoculated with the unmitigated small-pox virus, and the only means of reaching results more favorable than the average of cases caused by natural methods of contagion was to select virus from mild cases and to use it in small amount. Similar methods of inoculation for ovine variola or sheep-pox have long been practised in countries where this disease prevails; but with this plague as with human variola, it was almost an equal choice between the remedy and the disease. The remedy, indeed, produced the disease with all its symptoms, and frequently in its severest form. The inoculation which has long been practised in Europe for pleuro-pneumonia or lung plague of cattle is an example of more favorable results obtained by this same defective method; but these results depend upon a very marked and interesting peculiarity of this disease. The virus of pleuro-pneumonia, owing to some vital peculiarity which so far has evaded science, will not invade the whole animal body as does the virus of most other diseases. When the contagion occurs by natural channels the germs are drawn with the inspired air into the lungs, they multiply locally and produce intense inflammation of these organs and the membranes which cover them, but here their action ends; if the changes in the lungs are not sufficient to cause death, nature repairs the damage as well as possible and the attack is over. If the virus is injected beneath the skin of the neck, the germs again multiply locally, and now

an enormous inflammatory and gangrenous swelling is produced in this location which may cause death, but without a trace of inflammation of the lungs. If the virus is inserted in the end of the tail there is again a local swelling and inflammation; but owing to the nature of the tissues and the distance from the vital organs the consequences are far less serious, and but two or three die out of every hundred operated upon. Curious as it may appear, this slight swelling at the end of the tail, which disappears entirely within a few weeks, is still sufficient to grant a very complete immunity from this disease in the future; and inoculations into the tissues of the neck, which almost invariably produce death in animals which have not been operated upon in the tail, are no longer dangerous, and scarcely produce appreciable results, while exposure to sick animals is equally harmless. But even with this disease inoculation has its disadvantages. The virus multiplies at the point of inoculation; serum charged with it exudes at and about the wound and is scattered by the movements of the tail, over the stable floors, over the attendants, over other animals, and possibly into the milk pail. While, therefore, the animal obtains an immunity, it is only at the expense of renewing the infection of the stable and making it all the more necessary to keep up the operation with every new arrival. When the authorities of New York and New Jersey permit the inoculation of animals with lung plague virus as they are now doing, we can understand from this what will be the result: animals may be taken to infected stables with comparative safety, but there will remain infected stables as long as this operation is practised.

The discovery that those people who contracted bovine variola were afterwards exempt from small-pox was a great advance, not only from the practical standpoint of the prevention of this disease, but considered scientifically in its bearing on other diseases. The variola of cattle seems to be a modified form of human variola; or, in other words, the virus of small-pox after it has multiplied for a certain length of time in the body of the cow loses much of its virulence, produces a very mild disease, and is even changed from a virus which multiplies throughout the whole economy, to one which multiplies only at the point where it is inserted. The

nature of the modifications thus produced, and the exact conditions which are essential to these modifications, are even yet problems which confront the scientist and puzzle the philosopher; but we doubt not they are vital changes, — a sort of adaptation to the environment; the germ remains the same in form, but its requirements are different.

It was a long time before it occurred to the investigator that perhaps the conditions of life which were necessary to transform a very virulent virus into a comparatively harmless one, might be supplied in the laboratory of the biologist as well as in the laboratory of nature — that in fact this empirical practice might be made the foundation of a truly scientific one. The conception was most important; it is one of those great advances of science which prove the stepping-stone to achievements innumerable; it marks an epoch in medicine, and so long as men and animals are the prey of the microscopic parasites which constitute the virus of contagious diseases, the name of Pasteur will be remembered as one of the greatest public benefactors which the world has so far produced.

This discovery, however, was not reached at a single bound; it was the outcome of methods of research perfected by years of application in allied branches of science. As we look back to-day we can see that it depends upon many discoveries which at first sight appear to have but little connection with it. It was necessary to cultivate the disease germs free from contamination with atmospheric germs before they could be studied; but this could never have been accomplished until the theory of spontaneous generation had been exploded, since no pure species could ever be cultivated free from contamination if other similar organisms were continually arising. And so we learned that putrefaction was caused by microscopic organisms; that these could only arise from other similar things which had previously existed; that a broth in which such organisms had been destroyed by heat, and from which others were excluded, would remain sweet indefinitely, and might be used for cultivating and studying germs of various kinds. Apparatus for such work was perfected; and, finally, when science had advanced to the proper point, the man who, of all others, had been con-

spicuous in the studies to which I have alluded, succeeded in cultivating the virus of a contagious disease in such a manner that other germs were excluded. It was the virus of fowl cholera, and he soon learned that the preservation of this virus, under certain conditions in the laboratory, modified it, diminished its virulence, and enabled him to use it safely for conferring an immunity, as vaccine is used for protecting from small-pox.

Anthrax virus was then subjected to similar conditions, and it, too, was changed into a vaccine. We have all heard of the wonderful success of the vaccinations with attenuated anthrax virus in France, — how hundreds of thousands of animals have been made insusceptible to this destructive scourge at a very slight expense, and almost without loss. We have also heard criticisms of Pasteur, criticisms of his methods, doubts of his alleged discoveries, insinuations in regard to his standing as a scientist, — all originating from men who envy him the position which he has attained by years of patient toil, and by a devotion to science of which few are capable. But let us forget these unpleasant things; they are unworthy of the scientific men of this generation; let us rise superior to national jealousy, superior to personal envy, and during the lifetime of such worthy men, make it known that their gifts to humanity are duly appreciated.

Though the discovery of the attenuation of virus can no longer be contested, Pasteur's theory in regard to this has become untenable. I was, perhaps, the first to show that it was not the oxygen of the air which produced the change in germs, but that it was a loss of activity due to their old age, when preserved where multiplication was impossible. Chauveau has since added evidence which makes it very certain that this view is correct; and he and others have shown that the same loss of activity results from other unfavorable conditions of life, such as high temperature and contact with certain chemical substances known as disinfectants. There are, then, various ways in which an attenuated virus or vaccine may be produced, and some of these are much quicker and more uniform in their results than that of Pasteur, but all have certain objections. Pasteur's method requires much

time and skill in the preparation and use of the virus, and this deteriorates so rapidly that it must be used when quite fresh or its results are not satisfactory. Again, this modified virus penetrates too deeply, and sometimes produces more extensive local inflammation, and secures a less degree of immunity, than is desirable. In some cases, too, it is unsafe to the operator. The methods with heat and disinfectants do not require so much skill, but the other objections apply to them as well. But no method of attenuation yet discovered is sufficiently simple to be practised by the ordinary farmer or stock-raiser, and, consequently, if any practical benefit is to be derived from these discoveries, the vaccine must be prepared at a central point and distributed broadcast over the country. And when we attempt this we are confronted by difficulties too serious to be overlooked. It would be very wrong to thus distribute a virus dangerous to human life, like the anthrax virus, and this is almost the only one in which the prepared vaccine retains its activity a sufficient time to be sent to any considerable distance. Even the germ of this disease, which, from its peculiarity of forming spores or seeds, is the most stable of all viruses, rapidly becomes inert and useless after it has been subjected to the attenuating process.

The stronger and more active a virus is, the longer it is able to resist unfavorable conditions of life without being modified by them; and, consequently, if we were distributing virus to use at a distance it would be an object to send it in the most virulent condition possible. With this fact in view I commenced, several years ago, a series of experiments with diluted virus in the hopes of obtaining a method of producing immunity free from the chief objections which are urged against the methods I have mentioned. It is a question which many of the ablest experimenters had attempted to solve, but it had been abandoned again and again, and no very definite results had been obtained. The great trouble seemed to be that they worked with virus which varied enormously in strength. We can understand this when we examine the blood of a number of animals which have died of anthrax, for example. In one case we may find twenty, thirty, forty bacilli, even, in a single microscopic field, which

means that there are two millions or more in every drop; in another case we may find but two or three bacilli, and consequently there are scarcely a tenth as many as in the former case. In still another case it is difficult to find them at all. Now it is very evident that if we diluted each kind of blood with say twenty-five thousand times its bulk of water and used a drop of the mixture for inoculation, the first animal operated upon would receive into its body at least one hundred bacilli, the second not more than ten, and the third might escape without a single one. What wonder, then, that dilution experiments, made with blood in which the number of germs was never even estimated, should produce uncertain and confusing results.

The methods of cultivating such germs outside of the body, which reached great perfection during the investigations which were necessary to prove that certain diseases were caused by these germs, enabled us to take a step in advance of those who had previously studied this question. Each germ, we reasoned, must require a certain amount of food for its development, and, consequently, if the cultivation broth was always made of a certain strength and the germs were allowed to grow until they had exhausted the nutriment, there ought to be a practically constant number in every drop of every cultivation made under such conditions. And this proved to be true, and for years we have been able to produce at will a virus of fowl cholera which contained, as nearly as could be estimated, two and a quarter millions of germs in every drop. Even this did not produce exactly uniform results, because some birds were much more susceptible than others, but it enabled us to demonstrate some very important and interesting facts.

When the virus was diluted with five hundred or a thousand times its bulk of a harmless liquid it was noticed that a less number of the inoculated birds sickened than was the case when the strongest virus was used, while the disease when produced was as severe as before. When the dilution reached five thousand or ten thousand times, a still smaller number sickened and the attack was not less fatal than before. It was such results as these that had puzzled other investigators and led them to conclude that their dilutions

had reached a limit where a germ was no longer introduced with every inoculation, and that where a germ was contained in the drop of liquid used, the disease followed in all its intensity, while the failures were explained on the supposition that the drops of liquid used in these cases contained no germs. But we had numbered our germs, and we knew that every drop of a dilution of one to ten thousand contained more than two hundred of these, so that this explanation was no longer tenable. Fortunately we noticed that with many of the birds which remained apparently healthy there appeared a slight local redness and swelling at the point of inoculation within a week or ten days after the operation and remained until the twenty-first or twenty-second day. It was not exactly what was expected, but these birds were tested by inoculation with the strongest virus and they resisted it in a wonderful manner. They had, in fact, acquired a very complete immunity.

The virus of fowl cholera is one of the most virulent which is known to attack the lower animals, and yet we found that a single germ was incapable of injuring the most susceptible birds. It requires numbers, and very considerable numbers, to overcome the vital resistance of the animal body. As many as twenty-five germs were necessary to produce an apparent local congestion in very susceptible birds. Increase this number to seventy-five or one hundred and they were able to penetrate to the interior of the body, to multiply themselves to an almost infinite extent, and to set up those pathological changes in various parts of the body which lead to the death of the individual.

How wonderful these facts appear to us, and what remarkable avenues are opened up for future research! Why is it that a single active germ introduced into the tissues cannot reproduce itself indefinitely, as it does in a flask of broth, and succeed in developing the disease? What is the nature of the resistance by which the living tissues are enabled to resist such a germ and finally destroy it? How can a number of germs multiply where a single one cannot? Above all, how can such a local multiplication of germs confer upon the tissues of the whole body the power to completely resist enormous numbers of such germs for years afterwards? It

would appear that these questions have the greatest practical as well as scientific importance, and they deserve solution and must be solved in the immediate future.

We have here a new method of inoculation, which in many respects is free from the objections urged against the methods developed by European scientists; but it is still in the experimental stage. We do claim, however, that it is an important step in advance, and in spite of those who sneer at American investigations, we venture to predict that it will be of as much service to us in the future as some of the widely heralded discoveries of which the French and German laboratories have lately been so prolific.

Such studies, however, lead us to inquire if there is not something beyond vaccination or inoculation which would be far more satisfactory. A few years ago we could only cultivate disease germs in the animal body, — to-day we cultivate them more rapidly in the flasks of our laboratory. To-day we must introduce the living germs of contagious fevers into the animal, and allow them to confer the immunity in their own mysterious way. In the future we hope to force this secret from them, and to accomplish it in our own way and without their assistance. With this in view, we are now directing our experiments in such a manner as to learn, if possible, what is the nature of immunity, and how it is produced. The question is a difficult one, and has seemed almost beyond our grasp, but in one way and another we are getting nearer to it, and eventually we shall master it. We shall then be able to fortify against these microscopic enemies by a few doses of some chemical substance, as we now give other medicines, and thus the inconveniences, the danger, of introducing living germs into the body will be overcome.

If we should be somewhat disappointed in these anticipations, the great fact remains that the contagious fevers are produced by living germs which cannot originate spontaneously; that these are tangible; that they can be cultivated indefinitely outside of the body and studied, and that without such germs these destructive plagues cannot be produced. Hence the first indication for prevention is to destroy the germs wherever they exist, as you destroy weeds in your

gardens and fields, or dangerous and destructive animals in your forests. All living things can be exterminated, — the disease germ as well as the weed or animal, — and therefore the utility of stamping out such plagues, whenever this is possible. Our studies of germs come to our assistance even here, for we are learning what formerly we did not suspect, that what may be a good disenfectant in one disease may be useless in another. At present we test the effect of such agents upon the germ of a particular disease before we trust them implicitely as disinfectants. Carbolic acid, in solutions of sufficient strength, destroys almost all varieties of disease germs, but if this is diluted until the mixture contains less than one per cent., it is no longer reliable. It is not many years since we trusted implicitly in the disinfecting powers of carbolic acid, and we troubled our heads very little as to the strength in which it was used, or the liquids with which it was diluted, though these are essential points.

There are some diseases, such as fowl cholera, swine plague, black quarter and anthrax, which we cannot at present attempt to stamp out, and for these a safe, simple and effective system of vaccination would be a great boon. But there is much yet to be done before the viruses of these diseases can be safely manipulated and distributed over a great country like this, to be used by every farmer and stock-raiser who needs them. Details must be worked out, the operations must be simplified, and even new methods of attenuation and cultivation must be devised to meet conditions essential to some of them. There is too much at stake to allow of any blunders to be made, and it would be inexcusable for us to recommend practices before they have been thoroughly and systematically tested.

I have endeavored to present to you, in outline, the present aspect of the problems relating to the contagious fevers of animals, — I might say of men as well, — in order that you might understand what we are trying to accomplish at the Department of Agriculture in Washington. The losses from such plagues amount to many millions of dollars every year, and Congress has wisely decided that a small amount of money should be expended annually in their study, so that the vast stock-raising interests of this coun-

try might have the benefit of anything that the most advanced science of the present day can suggest. We are trying to grapple with these great problems intelligently, as becomes enlightened Americans in the last quarter of the nineteenth century. We have quietly fitted up a laboratory with all the facilities which are considered essential for the very best class of work; we have an experiment station, with stables, and sheds, and pens, and animals, to make thorough tests of every step in our progress. While we appreciate the excellent work that is being done in other countries, we have sufficient faith in our own country and its institutions to believe that just as good work can be done here as in any part of the world, and that it will lose nothing in value from being done by Americans.

Our work in the past has been devoted, to a great extent, to the demonstration of the germs which are responsible for some of our most destructive animal plagues. It was a necessary work and one which has consumed much time; but it must be remembered that we were working on the borderland of science, over problems that have defied the most acute investigators during all the past history of medical science. This work was contested step by step; but the application of the germ theory to our most important diseases has been made and demonstrated, and this demonstration is so plain that the most skeptical have been convinced. The demonstration that these diseases were due to living germs, and the subsequent study of these organisms, has appeared to many to have no practical bearing on their prevention and treatment. After all, says one doubter, you have only added another micro-organism to the long list already known; and what care I, says a veterinarian, whether the germs of swine plague are spherical or rod-shaped, I only want to know how to prevent and cure the disease. But such men forget that the science of physiology would have been impossible until anatomy was understood, and that physiology is equally essential to scientific medicine; they forget that the diseases of the stomach could never have been successfully treated until we had learned, first that there is a stomach, and secondly, what are its functions in the animal economy. The science of medicine does not stop with anatomy and physiology, but

it goes on to pathology and therapeutics; and we have never intended to drop our investigations with the demonstration of the germ theory, but we hope to push them forward until all the problems which I have referred to are solved, and perhaps others which may arise as the work progresses. We have confidence in patient, persevering work when properly directed, confidence in the scientific methods of the present day, and we feel certain that these researches will be continued until the most difficult and obscure questions connected with contagious diseases have received a satisfactory solution.

Now, as a sort of recapitulation of what I have been trying in my imperfect way to say to you, I would add that we have not the slightest doubt as to the correctness of the germ theory of disease. Not only can the germs of many animal plagues be easily seen and cultivated, but their identity with the active principle in the virus can be established beyond a doubt. Take, for example, the virus of fowl cholera, and if you heat it to 132° for fifteen minutes, you at once and completely destroy its activity; and it requires just exactly the same length of time and the same temperature to destroy the germs which exist in this virus. A single degree less for the same length of time leaves the germs capable of multiplication, and the virus capable of producing the disease. And so the virus is rendered inactive by precisely the proportion of carbolic acid, or sulphuric acid, or chloride of zinc, or iodine, or other disinfectant, which is necessary in a given time to kill the germs. The disappearance of life in the germ and activity in the virus at the same time and under the same conditions might in a single instance pass for a remarkable coincidence; but such remarkable coincidences are not found so regularly in nature that they can be interpreted in any other way than the identity of the germ and the essential agent in the virus.

The attenuation of the virus of certain diseases and the importance of the new methods of vaccination are also accepted as fixed facts. But the situation in America is much different from what it is in France. There one of the most fatal and prevalent diseases is malignant anthrax, and the virus of this happens to be the one of all others best suited for vaccination purposes, because of its peculiarity of forming spores,

which enables it to retain any degree of virulence which is conferred upon it for a very considerable time. In this country, anthrax occurs in such small areas and these are so far apart, that the success of such a practice would be doubtful even if we had skilled veterinarians to perform the operation. The plagues from which we suffer most are different; their viruses are still more unstable, and it becomes our task to master the conditions of virulence, and to learn not only how to attenuate the germs in a uniform and definite manner, but how to hold the virulence at this point for a sufficient time to enable us to send them to every part of this broad land.

Then the operation of vaccination as practised in Europe requires a skilful and experienced man; at present such men are not easily found in the greater part of the stock-raising districts of this country. It becomes necessary, therefore, to simplify the operation and to bring it within the comprehension of any man who can dock a lamb, milk a cow or lead a horse to water. It may not be an easy problem to solve, but we are in a land where Yankee ingenuity prevails, and what cannot be made practical in America is of doubtful utility to the rest of the world.

Besides these questions, so closely connected with the infinitely small organisms which constitute the virus of contagious diseases, there are other veterinary problems which will require all the skill, all the learning, all the appliances of the present day to solve in a satisfactory manner. In a little strip of territory along the Atlantic coast there prevails a lung disease of cattle which cannot be found elsewhere in this whole country. In some few points it has already prevailed so long that it is only the oldest inhabitants who can remember the time when they were free from it. Once in a stable, it frequently remains for months and years, and it is often carried considerable distances with cattle from such places. It is not the direct losses from this disease which makes it of such national importance; but it is the continual menace to the stock interests of the country, the vexatious and false alarms of pleuro-pneumonia here and pleuro-pneumonia there, where it has never existed, and where we hope it never will reach. These continued alarms make our stockmen anxious for their industry, fearful to invest their

capital, slow to purchase thoroughbred animals for the improvement of their herds; and, besides, they have been the means of placing restrictions on our trade abroad, which cause an annual loss of more than enough money to remove every trace of this bugbear from every herd which is now affected. When pleuro-pneumonia invaded the State of Massachusetts, and the nature of the disease was recognized, you wiped it out of existence by exterminating every affected herd; but your good example has not been followed as it should be by other States, and so the old question comes up again from year to year, and is more pressing to-day than it has ever been before. Our work at the Department is necessarily limited to a study of the nature of the outbreaks which are supposed to be caused by this disease, to watching the centres where it regularly occurs, and to quieting the apprehensions raised by the many false alarms. How much better it would be if, in co-operation with the State authorities, we were able to purchase and destroy every infected herd, and quarantine the premises until every trace of the disease had disappeared.

Our cattle trade is not the only one which has its restrictions, however, for the pork products, which make up so large a part of our exports, have been shut out of many countries because a small part of them are found to contain trichinæ. It is true that most of the trichinæ are destroyed by salting, and all of them by cooking; but we want to be able to say that the most carnivorous of our German friends can satiate their appetites with the rawest kind of uncured pork, and still not be in the remotest danger from this peculiar enemy of the Teutonic race. And while the great mass of our hogs are raised upon beautiful pasture lands, at a distance from every variety of offal and filth, this ought to be true; but unfortunately a small proportion of trichinous hogs do find their way to our markets, — where they come from and how they are infected is not yet clear. We have commenced investigations which we hope will throw sufficient light upon this subject to make our pork such as our fine pasture lands and the vegetable diet of our hogs should produce — by far the finest and the healthiest in the world.

Finally, we have a disease in this country which not only has already affected our export trade in live cattle but which is becoming a serious menace to the cattle industry in some of our best stock-raising districts. It has been known for years that there exists, somewhere in the South, a belt of territory the cattle from which when carried to the North infect the pastures and destroy a large proportion of the native animals while being apparently in the best of health themselves. It was also known that cattle taken from the North to certain parts of the South were almost sure to die from the effect, as was supposed, of change of climate. But these facts were never connected, the infected district was never outlined, and we were complacently informed that there was no danger of this disease ever penetrating, to remain permanently, beyond the line of frost and snow; some veterinarians even were skeptical of the existence of any such disease. It is almost incredible that in this country, with such an enormous capital invested in cattle, in this age of railroads, and telegraphs and newspapers, that we should so long have remained in such profound ignorance of the extent and character of this infection. Why, instead of being confined to a narrow belt along the Gulf coast, the district permanently infected with this disease extends from the Rappahannock in Virginia to the Rio Grande in Texas. Instead of being confined to the low, swampy coast, it stretches for hundreds of miles toward the interior, over sand and plain and hill and mountain; instead of being checked by the line of frost and snow this infection has pressed forward, slowly it is true, but it has advanced as certainly and regularly as time advances and as the seasons succeed each other. The line of frost and snow was passed a century ago, and yet it is taught to-day by cattle men and veterinarians that this infection cannot survive a single winter where frost occurs. This infected district instead of being insignificant in size covers an enormous territory, and all along the boundary-line, which is more than a thousand miles in length, there are disheartening losses of cattle every summer. This southern fever has been the great obstacle to the improvement of the cattle at the South; for nine-tenths of the thoroughbred animals taken to that section ultimately succumb to it. The

present losses, however, are as nothing compared to the possibilities of the future; for it is only now reaching the better cattle districts of the country. We are now outlining the territory already infected, and we are attempting to unravel some of the mysteries and contradictions connected with it. Our people ought to know in what parts of the South it is unsafe to buy cattle that are to be carried north; they ought to know the losses they will suffer when they attempt to stock their southern plantations with northern cattle; and they ought to realize that something must soon be done to check the advance of this, the most fatal of all cattle diseases.

It has been my endeavor, in what I have said to you to-day, to convince you that there was need for a Veterinary Division in the United States Department of Agriculture; and that this division, if it grapples with the work at hand, will have something to do for several years to come. I trust, also, that I may have been the means of increasing your interest, however slight it may be, in our young and little known profession, and the great work which it has before it.

The Chairman. It has been gratifying to see so much interest in this essay as has been manifested by your close attention. It is a paper which will repay study when it is printed in our Report. This question of diseases among domestic animals is one of the most important now before this country. We, here, do not feel it so much; we had our turn at it a few years ago, and, as the lecturer has said, we took most effective measures, and stamped out pleuro-pneumonia. It was a most heroic act on our part, and although it was severely criticised by men who were interested in the matter, the disease was stayed, and history has recognized the importance of our action at that time. Dr. Salmon will be very happy to answer any questions which you may desire to ask in the development of this matter. And, to commence it, I will ask him if he referred, in the last part of his address, as I suppose he did, — although he did not give the name of the disease, — to what is commonly denominated "Texas fever?"

Can you tell us what are the symptoms of that disorder?

Dr. SALMON. The symptoms of Texas fever are a drooping of the head, a lopping of the ears, general weakness, staggering gait in walking, with hæmaturia, with high fever, death resulting in the course of three days to a week. There is scarcely any other disease which can be mistaken for this, or which can be confounded with it, for the reason that the only other disease which assimilates very closely to it is the well-known anthrax. Animals affected with that disease die in from twelve to twenty-four hours. There is a disease which occurs in the spring, principally, but sometimes in the fall, which is caused by animals eating of the green and early shoots and buds of evergreen trees, and some of the plants which start early in the spring, which causes symptoms somewhat similar to those of Texas fever; but the time of the year when this occurs is sufficient to distinguish between the diseases, for Texas fever is seldom if ever seen in any other months than July, August, September and October. It is true that when the Texas cattle disease is carried a considerable distance from the district which is permanently infected with it, the infection dies out the first winter which succeeds; but the district which is permanently infected with the Texas fever is advancing further and further to the north and northwest; and I think it has passed the line of frost and snow, and passed the line where the temperature falls as low as six, and sometimes ten, degrees below zero nearly every winter. The infection in those lands in some way continues, cattle sicken upon them, herd after herd, and it seems almost impossible to rid them of this infection when once it has advanced over the line in this way. When it is carried a considerable distance beyond the permanent line, as I say, the winter seems to kill out the infection. But the whole border-line is infected, and as the disease advances, slowly but surely, the infection remains where it has gone, and remains in places where the temperature goes below nine or ten degrees below zero, and has remained there for five or six years, in some cases.

QUESTION. Will you tell us how it is that the infected districts do not become depopulated of cattle, and how it is

that the cattle bringing that disease north do not fall victims to it themselves?

Dr. Salmon. If I attempt to answer the question, I will have to do it by giving an opinion merely, because I do not pretend to understand it myself. It is true that young animals taken to the South contract the disease in a mild form. It seems to have but slight effect upon them: you will notice a little fever and loss of appetite for a few days, and they recover, and from that time on, they have immunity from the disease, — as great as the immunity from measles after the first attack. Now, whether all the young cattle in the South have a mild attack of this disease when calves, or not, I am unable to say, but whatever may be the explanation of the phenomenon, it is very certain that the cattle at the South do resist the germs of this disease in a most wonderful manner, even more completely than northern cattle which have gone there and had an attack of the disease.

The Chairman. If the cattle are brought from the South, they communicate the disease, and more cattle die in the region to which they are brought, from the infection, than the original cattle themselves.

Dr. Salmon. The original cattle seldom sicken at all unless they have been driven a long distance and are very much exhausted. They infect the pastures by grazing or running over them, and any native cattle which run upon those pastures afterwards are liable to the infection.

Question. Will an animal being infected from direct contact with this disease re-transmit it to a second animal?

Dr. Salmon. There is hardly a case that has happened at the North where it has been suspected that such a method of transmission occurred. I doubt, in fact, if there has ever been known a case at the North where a second northern animal has contracted the disease from the first one. Indeed, animals never seem to contract the disease directly from other animals, but from pastures on which animals from the South have lain or crossed. Indeed, along the border-line of this district in the South, it very frequently happens that an animal from the uninfected district comes upon the infected district, and there takes the disease, and that animal,

when it is driven to pastures which have not been infected, succeeds in some way in infecting the pastures there; but I do not know of a single case which is free from doubt, where an animal which has not come from the permanently infected district of the South has ever carried the infection to any other pastures.

Mr.———. Can this infection be carried by the voidings of the animal?

Dr. Salmon. I think so, but I have no facts bearing upon that point.

Mr. ———. I asked the question because it has been the custom, in the western part of this State, to purchase at Albany the manure collected at the stock yards, and it is dealt in very largely in that district.

Dr. Salmon. I should suppose people having cattle there would know something about that.

Mr. Myrick. I would like to ask the doctor his opinion upon a trouble which causes a loss every year to many farmers in New England, and that is, abortion in cows.

Dr. Salmon. I have not very many facts bearing upon that point. When I was in the South, two years ago, there was a herd which became infected with this trouble by an animal which was brought from another herd where the trouble had been known to exist for considerable time. I had always looked upon the disease as infectious or contagious. The man who owned the herd, which consisted of valuable Jerseys, asked me to assume the management of the case, and as he promised to carry out my directions implicitly, I did so. I disinfected the stables thoroughly almost every day with a solution of sulphuric acid, and we had but two cases after that disinfection, and those within a very short time, showing that the infection had commenced before the disinfection had been made, and that was the end of the trouble. "One swallow does not make a summer," but it is so seldom, where that disease enters a large herd, and particularly a herd of fine-bred animals like the Jerseys, that you get rid of it the first year, that I am inclined to think that our disinfection did have very considerable influence upon it. The man who owned the herd did not expect to get rid of it for at least three years, but we did get rid of it

the first summer, and the cows which had lost their calves the previous summer carried them, the next year, their full time.

Question. Has anthrax ever become prevalent in this country? If it has, what are its characteristics?

Dr. Salmon. Anthrax occurs in a few small districts in this country, — I do not know how many. The fact is, we do not know exactly what the diseases are which occur in many parts of the country; but that is almost the only disease where any considerable number of cattle are attacked and die suddenly; sometimes as suddenly as if they were struck by lightning. We generally decide what the disease is from this fact. The only scientific way of diagnosing the disease is to examine the blood, microscopically, for the germs which it almost always contains.

The Chairman. Is the foot-and-mouth disease known in this country?

Dr. Salmon. There have been two or three outbreaks of the foot-and-mouth disease in this country. There was one in 1868 or 1869, or perhaps two or three years later, in which the disease was imported by cattle brought from Canada; and another case occurred some two or three years ago, in which a cargo of cattle from England were landed at New York. Those cattle were quarantined at once, and the disease did not spread. Another cargo was landed at Baltimore, and the cattle were taken to Philadelphia, but the authorities got hold of the fact and quarantined the animals before the disease got outside of this herd.

Mr. J. T. Everett. We have all listened, I know, with great interest, to this learned and scientific lecture. I hear with difficulty, and this hall is a hard place to speak or to hear in. I wish this address could be more generally circulated than it will be under the laws that regulate the distribution of papers published by the Board of Agriculture of Massachusetts. It is, in my opinion, a very important document, treating a subject that affects millions of property of those of us who raise cattle. I wish there might be some measure adopted by the Board for the more general circulation of this document than has usually been the case with papers read before this body.

Mr. Hills of Plaistow, N. H. If I may be allowed, I would like to inquire of the doctor whether there are any simple remedies that may be used in cases of puerperal fever, as we term it, which occurs very often among cows, where they are well kept and in high condition.

Dr. Salmon. There are no very simple remedies for this disease; and, in fact, if it occurs in a bad form, it is usually fatal, in spite of remedies. The simplest way is to keep the cows in a low condition at the time of calving. The disease is not confined to cows that are well kept; in fact, it occurs often where cows are in poor condition. In such cases, the best treatment has been the application of irritating agents along the spine, cold applications to the head, and a dose of purgative medicine. I believe, also, the most successful practitioners give stimulants, such as carbonate of ammonia, perhaps, and nux-vomica.

Mr. Everett. I would like to inquire in relation to a disease prevalent, when I was young, in Worcester County, which was called "bloody murrain." A great many cattle were lost by this disease. They would be taken, perhaps, in one leg, with very rapid and great swelling, infused with bloody matter, and would usually die in two or three days. There were a great many died in the town of Princeton, where I reside, and some of the adjacent towns. For the last thirty years I have not seen anything of it in my own herds, or among those of the farmers surrounding me. Whether it is prevalent in other sections at the present time, I do not know. I would like to inquire of the doctor whether he knows about that disease.

Dr. Salmon. This disease is what we call "black water." It used to be considered as a form of anthrax, but within the last few years it has been discovered that it is an entirely different disease. It is very widely distributed over the country; in fact, over the world. It is one of those diseases of which the germs have been recently discovered, and from which we are endeavoring to obtain a vaccine. I do not know whether our efforts will be successful or not, but it is not improbable that in the future we shall be enabled to obtain a vaccine from the germs of this disease, which we can use in inoculating, and thus prevent it. At present

there is very little treatment which has proved very satisfactory; but of late years it has been customary to keep the cattle in herds where this disease prevails in a low condition, and when the first symptoms occur, to drive the cattle very hard for almost as long as they can stand up; and in the majority of cases this seems to be beneficial, and the animals recover.

Mr. ———. Is that disease considered infectious?

Dr. Salmon. It is a disease that can be produced by inoculation. It probably is acquired from the pastures in some way. I do not think there is great danger of animals taking it from each other.

Mr. ———. That is what I supposed from seeing isolated cases of it, not existing throughout the herd.

Mr. Myrick. Would feeding bone meal have any beneficial effect in those cases?

Dr. Salmon. I think not.

Mr. ———. I have noticed a good many times where farmers have been in the habit of feeding rye fodder, — that is, rye cut green and dried like hay, — that abortion was very apt to occur and be carried through the herd. I have known two or three farmers who have had their cows abort where they have been feeding rye fodder.

Dr. Salmon. It has been considered that there was a connection between these two, but I am not certain of it. It is one of those things that we do not know so much about as we used to think we did.

Mr. Peter Fay of Southborough. I have a fact to the very point that has been indicated in regard to abortion in cows. Some thirty-eight years ago, out of a herd of thirty cows, I had eighteen abort in the course of two months. At that time, I wrote to different individuals in New England in regard to that trouble. I never had anything of the kind in my herd before. All the information that I could derive from any quarter left the matter in the dark. Some had one theory, and some another. "You keep your cows too well;" "you feed too high;" "there is some trouble with your hay;" or "you have got something in your low lands that is injurious;" but there was nothing that gave me any satisfactory information. Then some said, "You must separate

your cows; then it will not go through your stock." I tried that, but it made no difference. Sometimes there would be two or three cases in a week. That same season, I purchased ten cows from the State of Vermont. They said, "You must separate your cows, abortion is contagious." I was not able to do it; my barns were not sufficient to enable me to separate all my herd. They said, "You will lose the whole of them." But here is the result: those ten cows that came from Vermont were all mixed in with this same herd, side by side, and I never lost a calf from those cows. There was a mystery about it. I have never been able to satisfy myself about it. I think it is one of the most obscure things that the farmers have to contend with.

Question. Did you feed cotton-seed meal?

Mr. Fay. No, sir; cotton-seed meal was not known forty years ago. I fed my milch cows with boiled potatoes and meal and hay; but I fed them no higher than cows ought to be fed.

Mr. Bowditch. I have made up my mind that this trouble is very contagious, and the result is sometimes almost instantaneous. I have always made it a practice, when I suspect a heifer may miscarry, to isolate her at once. In one case, a heifer was taken to a barn, some distance away from the others of the herd, in which I had an old cow, which had bred right regularly for seven years and was then about six months gone. The heifer lost her calf, and in about an hour from the time the calf was lost, this cow, which was just across the floor, in a box stall, began to sniff and smell. I watched her. She began to bellow, and appeared very uneasy and restless, walking about in the stall, and in two hours she lost her calf. In another case, where I had isolated the animal, I thought it was perfectly safe to bring her back, and did so, and put her by the side of the rest of my milch cows, and in three days from the time I brought her back, although there was apparently no reason for it, — there was no odor that could affect the other cows, and they had taken no notice of her, — the cow in the stall next to her lost a calf of only about six or seven weeks. I have studied into the subject as far as I could, and the more I have studied into it, the less I think I know.

Dr. Salmon. I have this question sent up to me: "Can abortion be propagated? Will the discharge from an aborted cow give the disease to another cow coming in contact with it?" That is another way of asking if it is a contagious disease, I suppose. There is no doubt that there are two forms of abortion, one of which may be the result of mechanical injuries to the animal, or which may result from improper food of some kind, or from the position in which the animal stands in the stable, or from slipping, or some such cause as that. I have never considered that this form of the disease could be contagious. It has seemed to me there was another form of the disease which was always produced by contagion or infection. In the case to which I have referred, which occurred at the South, the man who owned the herd said to me that he did not know of any way in which that disease could have started, except that the animal had slipped in crossing a pair of bars. I then said, "I don't believe it will spread." But in a few weeks there was another case; in a month more there was another; a week or two later there was a fourth. We began to see that we had an infectious disease. We were well satisfied of it, from the number of cases which had occurred. Then I said to the owner: "Perhaps this disease may start from mechanical injuries, and if so of course it may start from injurious food, from ergot in the hay, or some such cause." We went on and treated the case with sulphuric acid as a disinfectant, with the result I have stated, and succeeded in getting rid of the disease entirely. The man who owned the herd is a close observer, and a man who watches his cows carefully, — the last man whom you would think likely to overlook an important fact, — but he told me afterwards that in looking over his books, he had found that he bought a cow from a stable where this disease had occurred before, and that this cow had stood by the side of the cow that aborted. So that we had just as much evidence as we needed that the disease had been imported in this case; and I suspect that a similar explanation would apply to many other cases where it is supposed the trouble comes, in the first instance, from mechanical injury. There are very few men who have sufficient patience to watch these things closely enough to be able to

say with certainty whether there has been an opportunity for their cows to be infected or not.

Mr. Ware. The case stated by Mr. Bowditch calls to my mind one of a similar character. In my younger days, before this disease was very prominent, I had charge of a herd of cows, and among the milkers was a man who was very harsh. I always milked with the men, and one morning I noticed that this man struck two of the cows with his milking-stool on the part of her body where the calf would naturally lie, to make them stand round. I cautioned him about it, and that day, when the cows were turned out to pasture, those two cows aborted, evidently from mechanical injury. There seemed to be a panic of abortion at once in that herd. They commenced bellowing and running around the pasture, and within two or three hours, if I remember rightly, there were as many as four more cows aborted in the pasture. I felt that the trouble in this case was sympathetic, caused by the two cows that aborted from mechanical injury. There were no indications of anything of the kind, but it came from sympathy, and from the panic that seemed to pervade the whole herd; and the result was, that within an hour or two, there were four heifers, making six in all, that aborted. That was the end of it. This was at a time earlier than the period within which what has been called "the disease," has been so prevalent. It was something that was not known much about, except by accident; but in watching those animals, it seemed to me that it was caused, in all except the first two, by sympathy with the heifers that first aborted, where the abortion was caused by mechanical injury. Mr. Bowditch's case seems to correspond with the one I have mentioned. There was a heifer taken to the barn, and the smell was sufficient to affect the cow, and the result was about the same, although the cause of the abortion in the first instance was not mechanical injury. That was a very interesting case to me. I have often thought of it, and it seems to me that sympathy in a herd has a great deal to do with it. Instead of its being contagious, it may be accounted for from that cause.

The Chairman. Dr. Salmon is obliged to leave at once, in order to attend to his duties in the department at Wash-

ington. The subject seems to have excited a good deal of interest and the discussion must be carried on without his assistance.

Mr. EMERY of Lowell. Last year one of my heifers aborted in the pasture. This year I had twelve other cases at midsummer. I have looked at the matter with my best intelligence. I have watched my cows, and I cannot give any reason for it; but I have noticed some things that may, perhaps, be of benefit. I find that when a cow aborts at about four or five months, it does not hurt her; that is, her after-birth immediately leaves her, she eats, and appears well; she does not shrink in flesh. If a cow aborts within a month of calving, or less, the case is different; the after-birth is sometimes eight or ten days coming away; she loses appetite and flesh. I have had two instances this fall where I have killed and examined them carefully. In one instance, we found the womb so tender that one could put his finger through it. In the other instance, we found it deep yellow in color. I do not know that the yellow color would indicate anything. I have found that with cows that abort, it is hard to impregnate them again. I did not know but the difficulty might be with the male, and from that fear I have changed bulls three times this year. I find that nearly all of these cows that aborted cannot be impregnated at all. Some of them have been three or four months.

My feed this summer has been very high — higher than it was last year. I use cotton-seed, corn, oat and rye meal. My herdsman thinks that the rye meal produces more milk than cornmeal, and it has a favorable effect on digestion.

QUESTION. Were those twelve cows that aborted all served by the same bull?

Mr. EMERY. Nearly all of them.

QUESTION. How much rye do you feed?

Mr. EMERY. We mix the rye meal with corncob, oats and pure cornmeal, a quarter part being rye. I raise 100 or 125 bushels of rye, and feed it to my cows. I am confident they do quite as well, or better, than when fed upon corn-meal alone. I think corn is of too heating a nature when fed alone, and that it is better to put rye with it.

The CHAIRMAN. Did your first case occur from contact

with another herd, or from the introduction of foreign cows into your herd?

Mr. Emery. The first case I had was that of an Ayrshire heifer that I bought at the auction of Mr. Fay's stock. She was impregnated there, and when I brought her home, I turned her into the early pasture. In June she lost her calf. This year, I don't think I lost any until July; then they began to lose their calves, and in every instance but one, where they came too early, I have lost the calf. I saved one, but it was very hard work to do it.

Question. Have you noticed much difference in the milk production from this disease? Will not a cow give just as much milk, take it the year through, if she loses her calf at seven months, as she would have done if she had carried it the full time?

Mr. Emery. If they abort at four months, and come out well, they will generally increase their milk. I made the public statement three years ago, that I estimated fifteen per cent. loss on a herd of cows where they were fed for the best results for milk — between the milk-pail and the butcher. I have come to the conclusion this year that the loss is over twenty per cent. In two instances, this year, cows that I paid $50 for, have gone for $22.50. I don't think that a man can take a herd of thirty cows and work them for the best production of milk, and get through with less than fifteen to twenty per cent. loss on his herd. If a cow costs you $60, you are fortunate if you get $30 for her when you turn her off. I presume you will all agree that beef made from cows fed for that purpose at the last part of their milking, costs twice what you get for it. I don't think there is any other way, when you get through with a cow, than to send her to the butcher, to go into bologna sausages, which is the ordinary use of lean cow beef in this region. You will gain nothing by attempting to fat them. It is a loss of grain.

Question. Don't you think it is better for a man to get a herd of young cows and keep them for several years rather than get rid of them in three years?

Mr. Emery. You would find it hard to keep up the quantity of milk necessary to supply a regular demand. I have one cow that I have had eight years. She gives more

milk than I ever had from any other cow. After she had her third calf, she ran along four months after calving at sixteen quarts, and one season she made nineteen quarts. If I could replace that cow, or get ten cows as good, I would willingly give $2,000 for the ten.

QUESTION. What was her breed?

Mr. EMERY. Shorthorn. She never has lost any time. She has had foot-ail, or something of the kind. That is the only thing that ever troubled her. She has taken her food and drink regularly. I think she is worth any two cows I ever had.

Mr. EVERETT. What is her condition now?

Mr. EMERY. Her beef condition is low.

Mr. ARTHUR A. SMITH. I want to make one statement that will, perhaps, be interesting to this audience. I understand that in the western part of this State, during the very recent past, three different herds of cows have been troubled with this disease. In one herd, some eighteen cows; in another, about ten; in another, two; and in each case the owners of those herds, who had built silos, and filled them with ensilage, attributed the disease to the feeding of ensilage. Does Mr. Emery feed ensilage? and if so, can he not attribute this abortion to the feeding of that stuff?

Mr. EMERY. It so happens that I do not feed ensilage. I do not believe in ensilage. My feeding has been: one foddering of hay, with cut feed, composed of corn fodder and second crop hay, with meal and shorts. The cows are fed twice with the meal and shorts, and once with hay. The first year that I fed in that way I kept an account of what it cost me from the first of January. It was fourteen cents and two mills a day; but I reckoned the second crop at ten dollars, and the corn fodder at seven dollars a ton. I should say that, comparing corn fodder and the second crop with hay, for feeding purposes, I put them in too low. I think the facts were published at that time in the "New England Farmer." Last year I had nothing but very good English hay, my second crop having failed. I estimated my corn fodder at $12.50, and my hay at $20.00 per ton. It cost me about twenty-three cents a day. That does not include the labor. When

I get to the first of January, I shall weigh everything again, once a month, up to March, and know just what it costs me this year.

Mr. LANE. How much grain did you give to each animal?

Mr. EMERY. They are fed one quart of cotton-seed meal, a quart and a half of cornmeal, two quarts of corn on the cob, oats and rye ground together, and a peck of shorts each.

Mr. LANE. I don't wonder they abort. I should say it was too high feeding for health.

Mr. EMERY. I don't think the shorts add to the high feeding. I give them ten or eleven pounds of hay.

Mr. WETHERELL. Do the cows give milk enough to pay for all that feed?

Mr. EMERY. Yes. I have forty-five cows now, and milking thirty-six. They are making thirty-four cans of milk a day; most of them are nine and a half quart cans; some are eight and a half.

Mr. LANE. Don't you think you could make more money if you did not press your cows so hard, and have them better at the end of three or four years?

Mr. EMERY. I do not. Perhaps I would not have so much abortion; but I am not convinced on that point. The majority of farmers in Middlesex North are feeding higher than I do; some of them give four quarts of cotton-seed meal.

Mr. SESSIONS. If the feeding which the gentleman has described is to be called too high, the people in the Connecticut valley are all wrong. I know men who feed double the amount Major Emery has stated, and they buy their grain to make milk for sale. When a cow shrinks so that she does not give what they consider a paying quantity, she is sent to the butcher, and the money buys another cow. That is the way they do business, and they do not have abortion as the result. We must not recommend low feeding here. I believe that the quantity of grain that Mr. Emery indicated will keep a good-sized cow, but is really moderate. It is a question whether it would not be necessary to feed a large cow more than we would a small one, or

a naturally large milker more than one of common capacity. But I admit that if a man is keeping thoroughbred cows, valuable for their produce, that he wants to breed from as long as possible, then he must be more careful about too high feeding; but if a man is after a profit from milk, it seems to me that the feeding described is not excessive.

Mr. Ware. We seem to be drifting away from the subject of abortion. Prof. Miles, from the Agricultural College, I understand, has had considerable experience in that matter, and we would be glad to hear from him.

Prof. Miles. I was very much interested in the paper read by Dr. Salmon, and it was in a line which I have been myself investigating for a number of years. It is the germ theory of disease. As he passed to the discussion of abortion, there came to my mind several cases that may be of interest. From some of the remarks made, it would appear that we know very little about the cause of abortion. I think we do know somewhat in regard to it, though there are very many obscure things about it in its epidemic form. There are facts, however, which are beyond question. We get confused if we attempt to bring all of our cases under one law. There are a variety of known causes. We know that mechanical injury will produce abortion. Undoubtedly, what is popularly known as sympathy, where abortion has occurred, will have its influence upon other animals. There are other cases, however, to which these two causes do not apply. There are conditions of the system which are difficult to get at when we examine the animals as we see them. I was called upon at one time to make an examination of a number of cows that had aborted. They were thoroughbred animals, but not proving profitable, were sent to the butcher. They were examined to ascertain the cause of abortion. In several of the herd that were supposed to be barren, and butchered for that reason, it was found that impregnation had taken place, and abortion had occurred at different periods. That was clearly demonstrated. The uterus was in a plethoric condition, — just that condition that would cause it to contract when the period of heat came round. That was undoubtedly the cause in most of those cases. I had several cases of heifers that failed to breed, and by watching them

carefully, I found that they aborted at every period of heat. They would be impregnated, and when the period of heat came round, abortion took place. We keep our cows in a highly artificial condition, always housed, and there is a condition of the system in the best of them that will give rise to this disease. There is, moreover, I am satisfied, — I do not know, for I have not been able to test it, but analogies in other diseases seem to point in that direction, — there is a specific kind of abortion which may be conveyed by infection. All the evidence seems to point to it. I have made some observations from which I am inclined to think that the disease is propagated by some of the germs which have been mentioned by Dr. Salmon. So that, although we have very much to learn in regard to it, yet there are certain facts which are very well established. We should take those as they are, and then pass on and connect the unexplained facts by one law or the other.

Question. Is there any remedy for an animal in that condition?

Prof. Miles. I do not know of any remedy. Of course, those animals of which I have spoken, that were in that highly plethoric condition, were pampered animals. The remedy, I think, if commenced in season, would be to give them a little more exercise and a little less pampering. But in the cases to which I refer, it had been carried so far that I am satisfied no remedy would have availed.

Question. Could you ascertain that an animal was in such a condition while alive?

Prof. Miles. We did detect quite a number by close watching.

Mr. Grinnell. I would like to ask Prof. Miles about one cause of abortion which has not been mentioned, or, at most, but very briefly mentioned, but which, in my opinion, from some personal experience and from a good deal of reading, — for I have studied the subject as much as I could, reading that famous New York Report where they had a commission to investigate this matter, — I want to know if it may not be caused by some of the forms of ergot. Ergot is found in other plants besides rye; the ergot of commerce is from rye. Now I want to know if there may not be ergot in

some of the plants and grasses in the field? I have reason to suppose that that must have been the occasion of abortion in a herd of my brother in Milford, Conn., where he lost fifteen or sixteen calves in the course of a year, right along, one after the other, and they were thoroughbred Jerseys, and were not kept very high. Their stables were comfortable and well ventilated. There was no apparent external cause for abortion in his herd.

Prof. Miles. Ergot is frequently the cause of abortion. It is sometimes the cause when it is not suspected. It takes but very little ergot to produce this effect; it might be so little that it would not be noticed. There is much in this germ theory of disease, which was not developed so fully as I would like to have it. It is important that more should be known by the farmers in regard to this matter, so that their observations in the future may be worth more. In certain forms, these germs that Dr. Salmon spoke about, are very readily killed; when they grow and develop and produce spores, which are exceedingly minute, they are very difficult to kill. Now, those spores are the germs of what we consider the cause of those contagious diseases which he was discussing. A case of anthrax occurred among some sheep in France; Pasteur was sent for to examine them. He came and looked them over, and said, "There has not been anthrax on this farm for twelve years; what did you do with the animals that died then?" He was told that they were buried in a certain field. He penned some sheep over that place and they died of anthrax. He conjectured that the cause was in the buried sheep, but how was it possible for the germs to get to the surface from those buried sheep? He thought of the earth worms; he examined the earth worms, and found specific germs of anthrax in them. But he was mistaken in supposing the worms to be the cause of their transmission, for, under certain conditions, the germs would live on the soil for years; in certain other conditions, they may be very readily destroyed. Now, coming to this subject of abortion, where we have these epidemic cases breaking out very suddenly, without any apparent cause, it may have been from germs remaining in the soil, under conditions which we cannot define which have produced effect

now. We cannot tell how long those germs remain at any time, and the more I have studied this subject the better I have become satisfied that this germ theory of disease is going to unravel very many of these troublesome matters.

Mr. PAUL. I will ask you what was the cause of that excitable condition of the uterus of which you spoke. Was it from the quality or quantity of food?

Prof. MILES. In the cases I have examined I have no doubt it was largely hereditary. The condition of the animals was one that had been transmitted from generation to generation. They belonged to a pampered family, and they had been brought into such a condition that a slight overfeeding would produce this condition in them, when it would produce no effect upon an ordinary animal. You see you get conditions there of the nervous system that pass on from generation to generation.

The CHAIRMAN. Do you recollect what plants produce ergot?

Prof. MILES. No, I cannot give them. There is quite a large number of them. Ergot is upon rye as we notice it; on many of the grasses we have ergot in different forms. It would be easier, perhaps, to enumerate those where it does not grow.

Mr. CHEEVER. It grows on timothy grass quite frequently.

Mr. MOORE. I do not expect to throw any light upon this subject, and of course I will not occupy much time. I will say this: That when I was a boy we did not hear of abortion at all. The first that I knew about it was forty years ago. I had a large herd of cattle. Abortion went through the herd, and I lost half the calves. Then all at once it disappeared. Now if this germ theory is correct, there ought to have been enough of it left around my place to have kept the thing up. Then some ask, "Isn't it owing to high feeding?" I have observed it in a great many instances. In the town of Concord I have seen abortion go through herds where they were poorly kept on meadow hay the whole winter; I have seen it go through herds of cattle where they were fed as high as Mr. Sessions feeds his. It is an unaccountable disease. Now, in regard to the ergot

theory. There was ten times as much rye raised forty years ago as there is now, and rye has more ergot than any other plant that we grow. So I don't believe in the ergot theory. I know that cattle will abort where they are fed high; I know they will abort where they are fed low; I know they will abort in the pastures; and I think we shall leave this subject, knowing just about as much as we did when we started.

Mr. HERSEY. When we get a cow that will give twenty quarts of milk, we endeavor to breed from her. Now, when a cow gives that quantity of milk, it is necessary that she should be fed very high in order to maintain her condition. In feeding her high, you carry her out of the natural course, and, in doing so, you are carrying her out of good health. Now, then, will not poor health cause abortion? I do not say that it does, but by thus endeavoring to breed cows out of their natural condition, do we not breed them into that condition which is unhealthy?

The CHAIRMAN. If that theory were true, abortion ought to be more frequent than it is, as we make milk very largely.

Mr. NOBLE. After much trouble from abortion I concluded I could help the herd by supplying some needed material of their food, so I got ground bone and commenced feeding a certain quantity to my cows. I found that salt was a large element in milk, and I commenced feeding more salt and some saltpetre. I commenced that three years ago. My cows have saltpetre and salt regularly, and if I do not feed them a little bone occasionally, it is because I have sowed it over my pastures or used it as a fertilizer. I know nothing about the cause of abortion, but I can say that, under my new system of feeding, I have had no trouble from it. I feed a certain amount of salt regularly, with saltpetre and phosphates, in such quantity and in such manner as I think best adapted to the needs of my cows. I have also fed for the last two years an abundance of ensilage. I have not lost any calves under that treatment, and I have come to this conclusion, that among the many causes of abortion, one of them is the failure to supply the physical system of the cow with the elements which are constantly being drawn from her in milk.

Mr. Everett. Sixty or seventy years ago, there was nothing of this disease. Before we began to practise this high feeding, which has been brought about by the sale of milk in the great cities, abortion was unknown. But whether high feeding has caused abortion in our cows or not, at any rate, before we began to feed high, we had no abortion, and since we have fed high, with meal and the most nutritious food we could cram into the cow's stomach, to make the most money out of her we could, we have frequent cases of abortion. When we fed on hay and roots we had no abortion; but now, when our cows are fed with this highly nutritious food, we have abortion. My impression is that high feeding is the cause of it: I cannot avoid that conclusion.

Mr. Sessions. I do not feed as high as some of the farmers of the Connecticut Valley, but I have a neighbor who keeps a herd of cows in the old-fashioned way. He was born in Canada and he keeps them in the Canadian manner. They get what they can in the pasture, and he gets what milk he can from them. During the winter he keeps them on hay and corn fodder; they do not see grain from one year to another. He has had eight cases of abortion in the last year and a half: some in the pasture, some in the barn. I have had two in my whole experience, — five and six years ago. I keep twenty-five cows and he keeps about ten.

Question. Will you tell us how you feed your cows?

Mr. Sessions. To a cow in maturity, with a full flow of milk, I intend to give two quarts of cotton-seed, two quarts of Indian meal, and six quarts of bran, a day.

Mr. Russell. I am unable to unravel this net of contradictions which you have made here; but there is one point that has been brought to my attention of late that may have an important bearing upon mitigating the loss that we suffer from abortion. I am told that abortion commonly ceases in any animal after three times. This may not be a well-established fact and lacking proof, because, when cows begin to abort, they are usually turned into beef. But of late years some cows have become so valuable for pedigree, that they have been kept even after three times aborting, and it is on record that after three times many cows have recovered and

become useful breeders. I asked Dr. Salmon about it just as he was leaving, and he said that there was good reason for this belief. Where the disease is the result of contagion, or is transmitted by germs, as the veterinarians pretty generally agree that it is, it may be understood that there is a fair chance that after three times aborting a cow will resume her usefulness and her value.

Mr. Wheeler. If the suggestion of Prof. Miles is correct, that those cows that aborted still continued to breed at every period, but lost their calves, then that remedy cannot be relied upon. From my own investigation and experience, I have known it to run a long time, and I have had a great many such abortions in the same animal, provided it is abortion each time, as Prof. Miles suggests. I am inclined to think that is the true solution of the matter.

Mr. Brown. I know a farmer who has been feeding one hundred milch cows, with the usual trouble from abortion until he began to feed ensilage, then it almost disappeared from his herd. He separated fifteen heifers and fed them for several months before they calved, on ensilage, and every one of them carried her calf the natural time.

Mr. Emery. Perhaps acetic acid would have had just as wholesome an effect as ensilage.

Mr. Waterman. The only cases of abortion I have known in my region have been in herds fed from silos. They have lost heavily.

Mr. Paul. I have listened to the discussions at the meetings of this Board for a great many years, and the impression which I have before felt has been emphasized here this afternoon. Suppose a person ignorant of farming should attend these meetings to get knowledge and light? Would he not go away with the impression that we came to no agreement and do not understand the matters we discuss?

The Chairman. Would you advise that we should never discuss a subject upon which we are not fully agreed and do not fully understand? The object of these meetings is to bring out the experience of different individuals, and their opinions upon the several questions discussed. It is a well-grounded opinion among many who have written on the subject, that a great deal of this abortion may come from

contact with a bull that has served cows that have aborted, and that the disease is communicated in that way.

Mr. Hadwen. I believe that as much information has been derived from this discussion here as we have ever received from works written upon the subject. Of course, there have been twenty reasons given here this afternoon for abortion, and all of them, perhaps, are good, and for aught we know there are twenty more that are equally good. Every gentleman who has spoken upon the subject, that has had experience in keeping cows, must acknowledge the fact that they have had abortion in their herds, and they have all tried various remedies, with more or less success. I have had experience for forty years, and have attributed it to various reasons, and have never found any sure remedy, and never expect to; but I do think that cows kept in good condition, in a pure atmosphere, with good and nutritious food, with good care, where they cannot fight each other, where there is no danger of fright by dogs or by lightning, if you please, or from any cause, or, if you succeed in avoiding ergot in the hay or pasture, will have little of abortion. I think that the farmers must give their best care to their cattle in order to prevent it, and study all the causes and all the remedies; and I hope that, having investigated this subject, and having discussed it, as we have in this meeting, all of us will be profited by the discussion and be able to remedy the evil in our herds.

Mr. Sessions. Mr. Noble's suggestion that abortion was caused by the lack of phosphates and salt, leads me to state something of my own experience. I keep thoroughbred cows and breed them as long as they will breed. I have on my farm to-day a cow that is fourteen years old, that has bred me eleven calves. She is hearty and strong; never has had any appearance of abortion. It has been my custom to feed a great deal of wheat shorts, rich in phosphates. I have also salted my cows liberally twice a week, and the feeding of the bran has been as much, perhaps, with the idea that the animals needed phosphates from the lack of them in our pastures. It is pretty light food. It occurred to me while Mr. Noble was speaking that it was possible my exemption from this plague might have been for the reason he

gives. In the two instances which I have mentioned of abortion in my herd, the heifers became pregnant immediately afterwards without any trouble, and made good cows; so I have no doubt that those two cases resulted from some mechanical injury.

Mr. Stratton. Perhaps my experience in the matter of ensilage will be as good as that of any one present. I will say that I lost calves by abortion before I began to feed ensilage; I am now feeding a ton a day, and I have some cases of abortion. So I think it is safe to say that ensilage is neither a cause nor preventative.

Mr. Fitzpatrick. I have not been very much troubled with this disease, yet I have had some abortions amongst my cows. It is not through excessive feeding, for I do not feed very high. I have had it happen from fright, caused by dropping a trap door with a loud noise behind the cows. I think abortion may be caused by anything that deranges the system or is injurious to the health of the animal. Then ergot will, of course, cause it. As cows are now kept, they are generally milked too long. We milk up to within a few weeks of the time of calving, which is a severe tax, and tends to constitutional weakness and consequent abortion.

The Chairman. We have at Amherst, in the county of Hampshire, an institution of our own, an Agricultural College, where a young man can obtain a better education to fit him for the work of life, and at less expense, than at any other institution in the country. This college has had its troubles; it has not always, — and I, as one of the trustees, have a right to say so, — it has not always been managed in the best manner; but within the last few years the trustees have given their attention closely to it, and when we had a man to take charge of that institution, as we did have in the lamented President Chadbourne, it was brought up and strengthened so that it has become a great power, and is being appreciated by the people as worthy of their confidence and patronage. We have now at the head of that institution a man who, after the death of President Chadbourne, and after long search and examination, the trustees invited as President; a man whose whole heart is in his

work, and he enters into it with enthusiasm and zeal, tempered with judgment. This gentleman, our President, is now before you, and he will address you on the subject of the College — President James C. Greenough of Amherst.

THE PLACE AND THE WORK OF THE STATE COLLEGE.

BY PRESIDENT JAMES C. GREENOUGH.

The State College meets a want. The study of Latin and Greek maintains a very prominent place in our New England colleges, necessitating from two to four years of special preparation for admission. However valuable a course of study and training in the ancient classics may be, and its value I do not care to deny, there is an increasing number of young men whose educational needs the classic college does not supply. These cannot, or for good reasons will not, spend from two to four years in preparation for college, four years in college, and from one to four years in preparation for the business they have chosen. And many of the graduates of our classic colleges deplore the waste of the years spent in the study of the dead languages, and demand that the college course shall be so changed as to give to the modern languages and to the natural sciences most of the time now given to Latin and Greek. The State College, by its course as now proposed and in good part arranged, meets the wants of those young men who desire to pursue a college course of study, but do not wish to spend much time in the study of the ancient classics. The classic colleges continue the work begun in the classic department of our high schools, the State College should continue the work begun in the English department of our high schools. The State College will thus supplement the English high school, as the classic college supplements the classic high school. In the future as in the past many will successfully complete the college course who have never attended a high school, but have prepared for admission elsewhere.

The main object of the college course should be to form men intellectually and morally; but while doing this, by a well-arranged course of study and training the student can receive that practical instruction which will directly

prepare him to engage in some useful employment. The cultivation of the soil and employments connected with the cultivation of the soil are the employments most commonly pursued in our country. Farming, market-gardening, or arboriculture, landscape gardening, the production of fruits and kindred employments are the fundamental employments of the people of the United States.

Every scientific principle taught in a college course must be presented in some of its applications in order to be understood. In the State College the applications are made in the several departments of agriculture and in kindred employments.

I here touch one important difference between the proper work of the State College and the work of other institutions. For instance, the principles of chemistry are the same whether taught in one place or in another. The illustrations and the applications by which the principles are taught and understood are not the same in every institution. In the State College the illustrations and applications relate to agriculture. The same is true of botany. The same should be the method of teaching every department of science taught in the State College. There is also a department of agriculture for the benefit of those who are to engage in farming.

Is this plan in accord with the Act of Congress which provided for the establishment of the college?

The Act (I now quote its important section) provides, in the several States, for "the endowment, support and maintenance of at least one college where the *leading object* shall be, without excluding scientific and classical studies, and including military tactics, to teach such branches of learning as are *related* to agriculture and the mechanic arts, in such a manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." To the Act, as thus quoted, I will add a paragraph from the pen of my deeply lamented friend and predecessor, Dr. Chadbourne. He says:

"No branch of learning peculiar to the old colleges was to be necessarily excluded; but the new colleges were to push on to the

practical application of the sciences they taught, and they were to train all their students as defenders of their country against domestic rebellion or foreign invasion. In a word, they were to educate their students as men and as American citizens.

"The rank of the education given is *liberal*, the term applied to the education given by the highest institutions then known. It was to be so broad as to fit men for the 'several pursuits and professions of life.' The object of these colleges was to obliterate the supposed superiority of the so-called 'learned professions,' by securing a 'liberal,' that is, the highest education, for those who chose industrial pursuits, thus lifting agriculture and the mechanic arts from the plane of mere routine labor to the dignity of learned professions, founded upon scientific knowledge and allied to, or connected with, those branches of learning essential for a broad and generous culture of the whole man.

"Many who have attempted the management of these colleges, as well as many who have criticised them, have apparently overlooked the broad and generous plan upon which they were founded. It is doubtful if they will ever accomplish the great work for which they were intended, until their original purpose is so fully and constantly recognized and carried out by judicious, painstaking work, that the currents of education shall be once fairly turned toward these new channels. When once fairly turned, that they will continue to flow can no more be doubted than we can doubt the success of any natural process when not artificially obstructed. An education that gives boys what they need to daily use when they become men, commends itself as rational and practical. All true education should aim at this. And this certainly is the idea that is embodied in the bill founding the industrial colleges of the several States."

Such was the breadth of the foundation of the college and such the broad superstructure which the experienced and the enthusiastic Chadbourne would build.

Shall we fail to carry forward the work which he began, and which he so clearly outlined? We all say no.

The act in accordance with which the college was established does not require that it should be administered in the interest of one class of working-men. It has not been so administered. It shall not be. Young men have been fitted for a great variety of employments at this college as at other colleges. Some of the graduates are clergymen, some are lawyers, several are physicians, while the majority

are employed in different departments of productive industry. Some persons read the term "agricultural" in the title, and inquire if all the graduates are farmers. If the question is an honest one, it is an evidence of pitiable ignorance. If the question is put with a sneer at the farmers, whose sound judgment has largely guided the public affairs of this Commonwealth, and whose steady toil has in large degree ministered to its material prosperity, then the question is unworthy of a citizen or of a man. If the question is a sneer at the college because it does not propose an extended course in the ancient classics, then the question is an evidence of a miserable narrowness. Is a young man who cannot, or who, for sufficient reasons, will not, pursue the study of the dead languages to be deprived of a college course of study? That man is narrow-minded who regards the course of instruction proposed by a classic college as the only course admissible for a college, or who, having received an education by means of such a course, thinks there is no other way to intellectual respectability than the path he has travelled. I would not disparage the ancient classics. I have toiled too hard to gain the little I know of them, and prize that little too highly, to speak disparagingly of them. But to say that all liberal instruction must be run in one groove is not wise. Our varied industries at the present time require to direct them men of large culture; and while Latin and Greek are needed by theologians, and Latin certainly by lawyers, are these languages equally valuable to the superintendent of a factory, the manager of a railroad, the head man on a farm, or to him who toils in some department of the applied sciences? If it is claimed that the discipline from the study of these languages cannot be gained in any other way, I affirm the claim is yet unproved. We have not yet tested in our courses of study the disciplinary value of the study of the modern languages. We cannot be said to have fully tested in our colleges the disciplinary value of the thorough study of the English language.

But let us notice more closely the course at the State College in its several departments. And first let us notice the provision for the physical training of the students. Every

student receives military training under a United States officer, who is himself a graduate of the military school at West Point. During the last few months I have met several graduates of the college. As to the work of the college, I have found, as might be expected, difference of opinion; but respecting the military training which they had received at the college, there was the most marked unanimity. They all agreed that the physical results of the military training were very satisfactory. When military companies appear on parade, or lead processions on public occasions, there is often an impression that the erect position and regular movements of the soldier are for show. But one object of the training of a soldier is to secure bodily vigor and endurance, and while under drill the organs are put in that position which is adapted to secure health and vigorous movement. The military exercises are a corrective of the crooked and ungraceful positions which so many students are disposed to assume in their own rooms. The responsibilities of the military duties are in a considerable degree distributed among the young men in a way adapted to cultivate manliness and a becoming courtesy towards each other. The military training is also adapted to secure discipline. This is secured by action of the will, controlling during the drill the position and the movement of every part of the body. Hence the military exercises are a direct preparation for any manual employment in the prompt and efficient movements they require. But the student who thus brings his body under control of his will, does much towards bringing his intellectual powers under control. The military exercises, then, tend to secure physical and intellectual discipline. It is also evident that the military exercises develop the physique of the students, and secure promptness in action and the acquisition of useful knowledge. If war should occur, a graduate is ready to perform the duties of an officer in defence of his country.

The importance of the development of will-power, which the military and other exercises are adapted to secure, is evident when we consider that our intellectual as well as our moral advancement depends largely upon the action of the will. Some one brings before you a new fruit or a new

flower; but neither eye nor intellect will avail to give you definite knowledge unless the eye and the intellect are each acting under the direction of the will. It is a common remark that one can learn nothing definitely without careful attention. And what is attention but the intellect acting under the control of the will? If we consider our moral advancement we are still more impressed with the importance of will-power. I once heard ex-Governor Seymour of New York say that, in the discharge of his official duties while Governor, he had been called upon to consider many petitions for the pardon of criminals. In tracing their personal history, he said that he had become deeply impressed with the fact that men did not differ so much in their knowledge of what was right in conduct, nor in their impulses towards the right, but that there was a wide difference in their power of will, shown in varying degrees of personal control.

I now turn to notice the means of intellectual culture. Knowledge gained through the senses is the basis of all subsequent knowledge. In any course of instruction the observing powers should be carefully trained, that the eye, the ear and the hand may be accurately used in gaining knowledge. By our own observation we gain a knowledge of facts from which we infer the general truths of science. Any other approach to scientific truth is fictitious and treacherous. The value of our inferences of general truth is determined by the accuracy and thoroughness of our observations. Hence, in gaining a knowledge of scientific truth, the student must be so taught that he will for himself gain a knowledge of the facts from which, by his own reflection and reasoning, he can arrive at general or scientific truth.

And these studies must be so taught that they will be an effective means of developing the powers of observation. The study of plants or of animals or of any of the forms of the inorganic world will be of little use if the study is by books alone. The excessive use of books and the committing to memory of words is the intellectual ruin of far too many in our schools and colleges. The greater number who study botany study books about plants when they should be studying the plants themselves. In our crowded centres, with the appliances now found in our schools, it is

impossible to teach the structure, the growth and the use of plants as these should be taught. The State College has ample grounds. The means of teaching by means of the objects themselves are at hand. The course of instruction does not begin with putting a book into the hands of the pupil. There you will see Professor Maynard with his arms full of specimens from the garden or the plant house entering the class room. The specimens are put in the hands of the pupils, and under the direction of the professor the pupils find by their own study the facts to be learned. The students do not study words, they study things. They do not find out what others have said about things. They study, and find what they can say of that which they study. This mode of teaching is not possible everywhere. It is possible at the State College because the botanical class-room is near the plant house, and in the midst of wide gardens and fields filled with a great variety of plants. That such instruction is needed is evident from the utterances of many who have failed to receive it. It is often said that the advancement a pupil makes is in proportion to the interest which the study excites. Which is most interesting to you, to read about a beautiful tree or flower, or to see it? Classes become intensely interested in the study of plants themselves, who would be disgusted with the mere study of books.

The same method will be pursued in the study of minerals as in the study of plants. The specimens will be in the hands of the students, and under the direction of a skilful teacher they will gain a knowledge of the minerals by their own study. In the opportunities for the study of geology, it may be questioned whether any other section of the State offers equal advantages. It is a region that presents a great variety of formations, while the careful study and observation of Hitchcock, and other eminent geologists, have rendered the whole region a sort of labelled museum of geology. In the study of animals the methods pursued are those so successfully used by the great Agassiz.

The chemical department, through all the vicissitudes of the college, has ever held a high rank. The amount of practical work that has been done in the chemical laboratory is very large. The chemical work of the experiment station

naturally centres in and about this laboratory, so that chemistry as here taught in its various applications is seen to have a meaning and a value that do not appear elsewhere. The chemistry is, in the most intense meaning of the term, practical.

As students gain knowledge by the study of different departments of nature, they should also acquire the power of expression, both written and oral. This is to be gained in several ways.

1. By insisting in every recitation upon clear and independent statements.

2. By frequent written exercises in connection with classwork in all the departments. In a college course, practice in writing should accompany all other work. Finished and rounded sentences, imitated from Everett or some other famous writer, should not be the main object of the student's endeavor, but the ability to speak one's own thoughts, and to pen them with accuracy and ease. Style that results from conscious imitation is never fitting. It clogs thought.

3. The power of expression is also gained by the careful and critical study of the great masters of English.

It is not easy to estimate the value of the thought, the feeling and the endeavor treasured for us in our mother tongue. He who acquaints himself with the best literature of the English people, takes hold of the imperishable thought of the race foremost in the progress of the world, and shares the best product of that race. The uncertain extent of empire, the splendor of royalty, the movements of armies and the brilliant succession of petty politicians that pass in review as one considers the more striking events of history, all seem dim and insignificant when compared with the steady light which a great author throws upon the retreating and shadowy past, while with prophetic glow he illumes even the future.

Chaucer is worth more to us than all the martial glamour of his sovereigns. If Spenser's sweet music had not reached us, if Bacon had not appeared as a teacher of his own and of all subsequent times, if Shakespeare had not given us his almost superhuman revelation of human nature, if Milton had not swept from his lyre strains that can never die, the Eliza-

bethan period, with all its marked political events, would be of secondary importance. Literature, robing the material world with its associations, imparts to it even something of the beauty and excellence of our spiritual nature. A more than earthly light rests upon English paths trod by saint and sage. The dun heather and the scanty lakes of Scotland take on new beauty from the romance and song of Scott. There never was a plainer or more philosophic truth than that uttered by the poor Scotch carpenter, who said that, "it seemed to him that the country had grown more beautiful since Burns had written his bonnie little songs about it." What would the hills of Judea be to us if stripped of the associations which come to us through our English Bible.

The course in the study of English Literature at the college shall do something to at least introduce the student to the study and the appreciation of the wealth treasured in our literature. Under the present arrangement of the studies of the course we are dividing the students in part of their work into two sections, — the scientific and the literary section, and the scientific and the agricultural. Those who are to engage in farming or horticulture will thus constitute smaller classes and secure more thorough instruction, while those who are to engage in other employments will better secure the training they need. The literary and scientific section of students will devote a portion of their time to the study of the modern languages. Very much might be said of the value of a knowledge of French and German, as a means of keeping abreast the line of progress in science. The latest discoveries in science are often announced in these languages long before they are described in English. Another advantage is, the introduction of the student to the modes of thought of other nations. You must read an author in his own language to feel the force of his thought and to appreciate the tenor of his feelings.

The German and the English languages have largely a common source, hence a knowledge of German greatly aids a knowledge of English.

By the study of the French the student is led to some proper apprehension of the Romance element of the English language.

We have spoken of the work of the college in the several departments of science and literature; but man is above nature, and man's knowledge of himself is superior to any knowledge of the material universe. The course of study includes mental and moral philosophy; nor will knowledge of man in social and civic relations be excluded. Political economy and civil polity will find a place in the course.

The highest knowledge attainable by man is a knowledge of God. The study of nature and of man should ever be a means to this knowledge. There is no sufficient reason for making a State college a godless college. Neither should it be in any sense a sectarian college. The fundamental truths of our being, of God and of our relations to him, should be reverently taught throughout the course, without making use of any of the shibboleths of sect. It is especially needful that those who instruct in a State institution shall themselves deeply appreciate the importance of a true religious life. Unless the student is led to be loyal to God, and to subordinate all else to his convictions of duty, the soul, however richly freighted with learning and culture, may drift to utter ruin. No instructor who appreciates in any proper degree the opportunities for moulding the character of students can limit his work to the studies of the curriculum. By individual guidance and counsel he will awaken and nourish the better aspirations of the students. A large number of students gathered in one college does not favor this individual work. The State College is not yet so crowded as to prevent the faculty from caring for each student with a good degree of individual interest. If time permitted, I might speak of the helpful influence of the chapel services, now regularly held every Sabbath forenoon, and of the voluntary efforts of several of the students in maintaining religious meetings of their own. Much, very much, remains to be done, in this and in other departments of the college; but, profiting by the experience of the past, and aided by the increasing interest of the people of the State in its welfare, we believe that the college is destined hereafter, as never before, to be the people's college, providing needed means of culture for every section of the State.

The Chairman. President Greenough is here not only to instruct and interest you by his paper, but also to do some missionary work, and he will answer any questions which any of you may like to put to him in regard to the college.

No question being propounded, the meeting adjourned to the evening.

Evening Session.

The Board re-assembled at seven and a half o'clock.

The Secretary, John E. Russell, delivered a lecture upon English Agriculture, which was listened to by a small audience. It was not reported.

SECOND DAY.

Wednesday, December 6, 1883.

The meeting was called to order shortly before 10 o'clock, by Mr. A. P. Slade of Somerset, who said: —

The first thing on the programme this morning is a lecture by Mr. Pierce, on the subject of experiments with fertilizers. I have the pleasure of introducing to you Mr. John W. Pierce of West Millbury.

EXPERIMENTS WITH FERTILIZERS.

BY JOHN W. PIERCE.

Although so much has been said and written about fertilizers, that to many it has become an uninteresting subject, still it is one of vital importance to every tiller of the soil in the older States. It is generally conceded that the majority of the farms of our State are in an impoverished condition. Many farms, which once yielded abundant crops of hay, grain and potatoes, now produce but a meagre return of those staples without a large expenditure for manure. On many of them stable manure now fails to produce its former results. The editors of our agricultural journals are con-

tinually receiving from correspondents such questions as these: How can I bring up a run-down farm? Will it pay to buy chemical fertilizers? Will commercial fertilizers do as well as stable manure? What kinds of fertilizers shall I buy? These also are questions which, for a number of years, I have been trying to answer for myself, and to-day, at the request of your Secretary, I propose to tell you in a plain way, from a practical point of view, how and what answers I have obtained; answered, in part, by a careful study of what others have done and written, and, in part, by a close observation of many experimental plots to which I have applied different fertilizing materials in different proportions.

Chemists tell us that our growing plants are composed of fourteen or more elements; four organic or volatile elements, viz., carbon, oxygen, nitrogen and hydrogen, and ten inorganic or assistant elements, viz., phosphorus, sulphur, silicom, chlorine, potassium, sodium, calcium, magnesium, iron and manganese. Science also teaches us that without sufficient supply of each of these elements in an available form, our crops must fail to grow. It has been found that the air furnishes an abundant supply of all the organic or volatile elements except nitrogen, and that the soil must furnish a part of the nitrogen and all the saline elements. That is, a soil that is deficient in nitrogen or any one of these saline elements, is practically barren, until the needed element is furnished, even if it be ever so rich in all the other elements of plant-food. Numerous experiments have demonstrated that our cultivated fields contain sufficient supply of all these required substances except nitrogen, phosphoric acid and potash, and that if we furnish these three with lime and magnesia in some instances, in the proportions found in the perfect plant of the kind we wish to grow, and in available condition, we have a complete manure, and, under ordinary conditions, a perfect substitute for stable manure, with the advantage of less weight and bulk to handle, and a quicker action.

The use of commercial fertilizers containing these needed elements, and in such proportions as the proposed crops require, is a step in the direction of higher and more scientific agriculture, but it is not so far as we should expect to go in

the intelligent and economical use of fertilizers. To find out whether each of these substances is wanting in the soil of each farm or field, and the smallest proportion of each with which we can obtain maximum crops, is another step, and a longer one, in advance, of supplying each substance to every soil in the same proportions, or in the proportion found in each crop. To furnish enough of each of these elements to grow a crop on any soil is much like the quack doctor who gave his patient a mixture of all the medicinal drugs with which he was acquainted, so as to be sure and hit his case with one of them.

In fact, as different crops remove different proportions of these elements of fertility, and while some crops are sold off the farm entire, others are fed to stock on the farm, and when so fed different kinds and conditions of stock remove varying quantities of these elements, so that stable manure seldom, if ever, returns to the soil just the same proportions of these elements of fertility as are removed by the crops, and as different soils in their natural condition vary in their composition, it is more than probable that the soil of many of our farms is unequally impoverished, or thrown out of balance, so far as fertility is concerned. To arrive at some definite knowledge of the special requirements of the soil of my own farm, in the spring of 1879 I procured a variety of chemical fertilizers, prepared under the direction of Prof. W. O. Atwater, and applied them each on a separate plot on half an acre of worn-out land, for the purpose of testing the soil after the manner proposed by the "American Agriculturist." On two other plots I used, upon one ashes, and upon the other sulphate of magnesia. These plots were parallel to each other, one rod wide and eight rods long.

The fertilizers were applied half in the hill and half broadcast. They were planted with corn, and in the following table I give the kinds and amounts of fertilizers used, and their respective yields: —

TABLE I., 1879.

No. of Plot.	KIND OF FERTILIZER.	Amount of Fertilizer.	Cost of Fertilizer.	Shelled Corn, in Pounds.	Stalks, in Pounds.
No. 1,	Nothing,	–	–	9	36
2,	Dissolved bone-black,	30 lbs.,	$0 70	36	94
3,	Nitrate of soda,	20 "	1 00	8	50
4,	Muriate of potash,	20 "	60	20	99
5,	Nitrate of soda,	15 "	1 35	16	81
	Muriate of potash,	20 "			
6,	Dissolved bone-black,	30 "	1 25	50	160
	Muriate of potash,	20 "			
7,	Dissolved bone-black,	30 "	1 40	36	138
	Nitrate of soda,	15 "			
8,	Dissolved bone-black,	30 "	1 90	44	165
	Nitrate of soda,	15 "			
	Muriate of potash,	20 "			
9,	Sulphate of lime,	18 "	12	10	46
10,	Sulphate of magnesia,	15 "	22	26	65
11,	Wood ashes,	1 bush.,	25	24	90

It will be seen by the table that dissolved bone-black, furnishing only phosphoric acid and sulphate of lime, produced the most marked results, giving the largest increase of any one material either used alone in No. 2, or with the other materials in Nos. 6, 7 and 8. But when used alone, although it started well, with the best color, yet, after it had grown a while, it seemed to blast, indicating that the bone-black alone was not sufficient. Although thickly set, the ears were small and the fodder short. It was the earliest plot to ripen. When used with potash in No. 6, it produced the best results. Potash alone in No. 4 increased the fodder, but not the grain, and did not ripen. Nitrate of soda did not seem to do much good anywhere. While it was the most expensive

material it increased the fodder but little and seemed to lessen the yield of grain. Gypsum, or sulphate of lime, but slightly increased the crop, indicating that it was phosphoric acid instead of lime that was needed. Sulphate of magnesia, which is generally considered of but little value as a fertilizer, showed a decided effect, especially by increasing the proportion of grain to the fodder. It produced more grain than any other material when used alone, except dissolved bone-black, and more than potash and nitrogen used together in No. 5. The most remarkable part of this experiment was the result of a mistake which does not appear in the table. Wood ashes were accidentally dropped in 12 hills where sulphate of magnesia belonged, but were mostly taken up as soon as the mistake was discovered, and nothing more was thought about it until the 12 hills were seen going ahead of the rest. These 12 hills, with both sulphate of magnesia and wood ashes, seemed to produce proportionally more than any of the plots, which must have been due to the reaction of the sulphate of magnesia on the ashes, rendering them more readily available as plant-food. While none of these plots produced paying crops that year, as it was a cold, wet and unfavorable season for corn, the soil being quite exhausted and the planting on a sod matted with quack-grass roots, still the experiments were more valuable than they would have been under different conditions, and besides affording me a great deal of pleasure I learned from them valuable lessons which subsequent experiments have confirmed; and the knowledge thus gained has been a decided source of profit to me.

The succeeding year, 1880, I repeated these experiments with corn on the same plots, and added others, and in Table II. I give the results : —

TABLE II., 1880.

Number of Plot.	KIND OF FERTILIZER.	Amount of Fertilizer per Acre.	Cost per Acre, including application.	Fodder, in lbs., per Acre.	Shelled Corn, per Acre, in Bushels.	Cost, per bushel, including Fodder.	Profit or Loss per Bushel.
No. 1,	Nothing,			1,460	23	$0 82	$0 18
2,	Dissolved bone-black,	300 pounds,	$6 75	1,820	34	78	22
3,	Nitrate of soda,	200 "	11 50	1,800	27	1 13	13
4,	Muriate of potash,	200 "	6 50	1,440	25	1 02	02
6,	Dissolved bone-black,	300 "	11 75	2,160	42	77	23
	Muriate of potash,	200 "					
7,	Dissolved bone-black,	300 "	14 25	2,080	38	91	09
	Nitrate of soda,	150 "					
8,	Dissolved bone-black,	300 "	19 25	2,560	45	89	11
	Nitrate of soda,	150 "					
	Muriate of potash,	200 "					
9,	Plaster, or sulphate of lime,	300 "	2 70	1,480	27	80	20
10,	Sulphate of magnesia,	300 "	4 25	1,400	28	85	15
11,	Wood ashes,	20 bushels,	9 00	2,460	48	65	35
	Sulphate of magnesia,	200 pounds,					
12,	Salt,	1¼ bushels,	7 00	–	44	63	37
	Lime,	2½ "					
	Wood ashes,	20 "					
	Plaster,	200 pounds,					
13,	Stable manure,	7 cwts.,	44 25	–	56	1 18	18
	Dissolved bone-black,	200 pounds,					

In this table the amount and cost of fertilizers and yields are all reduced to acre rates, and the cost per bushel, including labor, interest and taxes, is given with the profit or loss per bushel. The shelled corn was valued at 67 cents per bushel, and the fodder at $10 per ton, or 33 cents for the average amount with each bushel, so that a bushel of shelled corn and the fodder produced with it is valued at $1, and the profit or loss per bushel is found by the difference between the cost on each plot and the value at $1 per bushel.

Although the crops on all the plots were more satisfactory than the year before, yet the relative yields were much the same. The two years' experiments seemed to indicate conclusively that corn must have an abundant supply of phosphoric acid, and that the soil of this field was deficient in that element, for every plot without it in some form was but little better than with no fertilizer. While in 1879 nitrate of soda seemed to lessen the yield of grain, in 1880 it increased it a little, but in no case enough to pay for its cost. In the first year's experiments, wood ashes used alone did not seem to do much good; but the second year sulphate of magnesia on the same plot, No. 2, with ashes showed the best results. They worked as well together as was indicated by their accidental mixture the previous season. Ashes with salt, lime and plaster, did nearly as well also. Wood ashes furnish both potash and phosphoric acid, as well as all the other saline constituents of plant-food; but it is evident that they need the solvent action of the sulphate of magnesia, or the salt, lime and plaster, to dissolve and diffuse them through the soil and render them available as immediate plant food.

In the following spring of 1881, at the suggestion of Prof. Atwater, I commenced on adjoining land a new and more complete set of experiments, designed more particularly to test the effect of different nitrogeneous fertilizers in one-third, two-third and full ration; but also continuing the tests of superphosphate and potash. This set consisted of twenty plots of one-eighth acre each. The plots, as in the first set, were each one rod wide and eight long, and arranged parallel to each other. They were intended to be carried through a rotation of several years, with corn first, followed by po-

Table III.

Number of Plot.	KIND OF FERTILIZER.	Amount of Fertilizer per Acre.	Cost of Fertilizer per Acre.	Corn, 1881.			Potatoes, 1882.	
				Bushel Corn per Acre.	Pounds Fodder per Acre.	Increase over Average of Mixed Minerals.	Bushels of Potatoes per Acre.	Increase over Avge of Mixed Minerals.
Plot 1,	Nothing,	. . .	–	10.3	860	–	71.	–
2,	Nitrate of soda,	150 pounds,	$6 00	11.7	1,080	–	69.	–
3,	Dissolved bone-black,	300 "	5 25	16.0	1,360	–	70.7	–
4,	Muriate of potash,	150 "	3 75	17.7	1,640	–	93.7	–
5,	Dissolved bone-black,	300 "	11 25	14.3	1,140	–	81.4	–
	Nitrate of soda,	150 "						
6,	Muriate of potash,	150 "	9 75	23.0	1,960	–	89.3	–
	Nitrate of soda,	150 "						
7,	Dissolved bone-black,	300 "	9 00	34.6	2,220	–	127.	–
	Muriate of potash,	150 "						
8,	Dissolved bone-black,	300 "	15 00	34.0	2,200	0.4	130.	5.8
	Muriate of potash,	150 "						
	Nitrate of soda,	150 "						
9,	Dissolved bone-black,	300 "	21 00	35.7	2,440	2.1	123.3	0.9
	Muriate of potash,	150 "						
	Nitrate of soda,	300 "						
10,	Dissolved bone-black,	300 "	27 00	41.4	2,660	7.8	123.4	0.8
	Muriate of potash,	150 "						
	Nitrate of soda,	450 "						
11,	Dissolved bone-black,	300 "	9 00	37.7	2,400	4.1	119.3	–
	Muriate of potash,	150 "						

12, . .	Dissolved bone-black, ...	300 "	14 63	39.4	2,720	5.8	132.3	8.1
	Muriate of potash, ...	150 "						
	Sulphate of ammonia, ...	112½ "						
13, . .	Dissolved bone-black, ...	300 "	22 25	40.3	2,720	6.7	118.0	6.2
	Muriate of potash, ...	150 "						
	Sulphate of ammonia, ...	225 "						
14, . .	Dissolved bone-black, ...	300 "	25 87	39.4	2,440	5.8	129.7	5.5
	Muriate of potash, ...	150 "						
	Sulphate of ammonia, ...	337 "						
15, . .	Dissolved bone-black, ...	300 "	9 00	28.6	1,980	–	126.4	–
	Muriate of potash, ...	150 "						
16, . .	Dissolved bone-black, ...	300 "	15 75	35.4	2,200	1.8	131.0	6.8
	Muriate of potash, ...	150 "						
	Dried blood (⅓ ration), ...	225 "						
17, . .	Dissolved bone-black, ...	300 "	22 50	37.0	2,120	3.4	139.3	15.1
	Muriate of potash, ...	150 "						
	Dried blood (⅔ ration), ...	450 "						
18, . .	Dissolved bone-black, ...	300 "	29 25	39.0	2,480	5.4	138.6	14.4
	Muriate of potash, ...	150 "						
	Dried blood (full ration), ...	675 "						
19, . .	Dissolved bone-black, ...	300 "	9 00	*	–	–	–	–
	Muriate of potash, ...	150 "						
20, . .	Nothing, ...	–	–	*	–	–	–	–

* Left out, owing to mistake in measurement.

tatoes, oats, clover and timothy. This set has been continued in this plan to the present time, and in Table No. III. (see pp. 70–71) are given the kinds, cost and amounts of the materials and the respective yields for the first two years with corn and potatoes, as well as the differences between the plots with nitrogeneous materials and the average of mixed minerals or superphosphate and potash.

In this series it will be noticed that potash comes to the front and takes the lead of superphosphate, yet, as in the other experiments, both potash and superphosphate are needed. This difference is probably due to inequalities in the soil, which were also evident in some of the other plots. Both series of experiments were in the same field, but the part occupied by these was in much better condition to begin with than where the others were, having been planted more recently, with better tillage and more manure.

The effect of nitrogeneous materials seems to be about the same on all the plots which received them, and it will be seen by the column of differences between the average yields of the plots with only potash and dissolved bone-black and those with added nitrogeneous materials, that it makes but little difference whether the nitrogen is supplied in nitrate of soda, sulphate of ammonia, or dried blood, or whether in one-third, two-thirds, or full ration. In all cases it increases the foliage, particularly early in the season, and gives the crop a more vigorous appearance, but at harvest the scales indicate but little advantage from its use.

In most of similar experiments by others reported to Prof. Atwater, nitrogen benefited potatoes much more than corn; but with me there was but little, if any, difference whether on corn or potatoes. The same fertilizers were applied in the spring of 1883 and the field was seeded down with oats, clover and grass. The oats did well, with the same general appearance on the different plots as the corn and potatoes showed; but it would require so much extra labor to harvest, thresh, and weigh each plot of oats separate, that I felt that I could not afford to do so and harvested them together, noting that they were ripest where the superphosphate was used alone, and quite green where only potash was applied, while the heads seemed the heaviest with

both potash and superphosphate. There was much lodged straw where the nitrogeneous fertilizers were used, the amount of lodged straw increasing with the amount of nitrogen used.

It was also interesting to notice the special action of these different fertilizing materials on the plants. It is generally recognized that fertilizers act in various ways on soil and crop. One of these special actions is of a physiological nature, modifying the development of the plant. This action was very noticeable in these experiments. Superphosphate always stimulated an early development of the plant, with very dark-green foliage, and on potatoes a thick, curly appearance in the leaves. It also hastens the ripening of the crop and increases the proportion of seed to the stalk. Nitrogeneous materials also hasten the development of the plant, but increase the amount of foliage more than the seed. Potash induces a slow and sickly growth at first, with very light-colored foliage, but it lengthens the life or growing season of the plant, and if the other constituents of plant-food are present, it greatly increases the crop; but where the soil is deficient in other needed constituents of plant-food, it only induces the plant to make a useless effort to do what it cannot; and under such circumstances we only get a lot of flashy foliage. On good land superphosphate will produce very early potatoes with many in the hill, but potash on such land will give a larger, later and better crop, with nearly all large ones.

By some it is claimed that such experiments are on so small a scale as to be valueless; that the difference of fertility in different parts of the same field would often equal the difference in yields of different plots, and thus vitiate the result. These objections are, to a certain extent, true. Farming, from the fact of the varying composition of the soil, the changeableness of the weather, and the variation in the composition of the same crop grown on different soils, can never become an exact science. All we can expect is to reduce it to an approximation to exactness. These experiments, while they are not exact, can, by repetition on the same plots and on other parts of the farm, be rendered near enough to exactness to answer for practical purposes;

and if such mixtures as they indicate to be most profitable are made and used on larger tracts for our principal crops, and modified from year to year as seems to be needed, they will be found to accomplish all that is claimed for them. I have yearly supplemented these small experiments with such mixtures as they seemed to indicate to be most profitable for different crops, used either alone or with stable manure, and I have found the larger experiments to correspond with the results indicated by these small plots.

I have thus briefly reviewed some of the principal experiments which I have conducted in this small way, and now we naturally come to a consideration of the results. First, what advantages have I derived from them? Before I commenced these experiments it appeared that my soil was deficient in phosphates, from the fact that the stock grown on the farm were inclined to be small, and all showed a great desire to chew bones; and that the small quantities of superphosphate which had been used in the hill for hoed crops produced very favorable results in a general way: but I had got the idea that potash was not needed to any great extent. By these experiments I find that the soil is deficient in both phosphates and available potash, and that when these two constituents of plant-food are liberally supplied in soluble form, with possibly a little sulphate of magnesia, they seem to be all that are needed for any crop I desire to grow; that while the addition of a small amount of any nitrogeneous fertilizer seems to stimulate an early and vigorous growth of foliage, it seldom if ever increases the product enough to pay for its cost, and that a large amount of nitrogeneous fertilizer is often injurious.

After trying for several years to bring up a run-down farm, and make it support two families instead of one, depending for fertilizers mainly on the manure made on the farm, and trying to make a little manure and a good deal of tillage produce abundant crops, I have found by these experiments which constituents of plant-food are needed to restore the fertility of the soil I cultivate, and that while to supply those elements by the manure made on the farm, or the purchase of either stable manure or the so-called complete manures in the market, was too expensive a process,

yet by buying these needed materials, and them only, in chemical fertilizers, I could feed my crops liberally, and at a very much less expense. Since I first discovered this fact, I have yearly increased the use of these chemical fertilizers, and find that my profits have increased in a similar ratio. I have found that I could grow corn, and probably many other crops, cheaper on chemicals than on stable manure. By keeping as exact an account of fields with chemicals alone, and those with stable manure, I am satisfied that chemicals, if rightly used, are as cheap as stable manure at $4.00 per cord, including carting and spreading it on the field, which is much cheaper than I can make or buy it.

What advantages can others derive from these experiments? If you take these experiments of mine as your guide, and depend on them for a knowledge of what fertilizers are needed on your different farms, you will probably derive but little, if any, advantages from them. I have not reported them for any such purpose, but rather to show you what I have learned for myself, and the process by which I have done it; and by telling you how much advantage I have derived thereby. I hope to induce others to undertake such work for themselves. These experiments, taken alone and by themselves, are only a guide to me and those in my immediate vicinity. But general averages, obtained by comparing such experiments, conducted in different localities, are of general value. By comparing these experiments with others conducted in different parts of the country, and reported to Prof. Atwater, as published in the "American Agriculturist," the reports of the Commissioner of the State Board of Agriculture, and in 1882 by the Department of Agriculture at Washington, we find that they correspond very closely with the average of all the others, the only exception being, that in most of the experiments reported to Prof. Atwater, potatoes and oats were benefited more by the addition of nitrogeneous materials than corn, while with me there wa but little difference in its effect on either. But many of these different experimenters obtained results varying greatly. Some of them found superphosphate to be almost a specific for their crops, especially for corn. Such was the result obtained by Mr. Bartholomew of Putnam, Conn. Others, like

Mr. Chester Sage of Middletown, Conn., found potash to be nearly all that was needed. Still others, like myself, found both phosphoric acid and potash to be needed; and, again, others found a complete fertilizer, furnishing phosphoric acid, potash and nitrogen, to be the most profitable. Such was the experience of Mr. Atwood, Watertown, Conn. In most cases the addition of nitrogen was found to be unprofitable; but there was one notable exception, that of Mr. Newton of Durham, Conn., who found "that every plot without nitrogen was a failure, and every one with it gave a large yield, and the produce rose and fell regularly with the amount of nitrogen applied." By these exceptions I have cited, you will see that this is a work you cannot delegate to our experiment-stations or others, but each one must do it for himself, and repeat it every few years.

While the average of all these experiments reported to Prof. Atwater show that the mixture of phosphoric acid, potash and nitrogen gave the largest yields, yet when used on corn, in but thirty experiments out of one hundred and fifty, did the addition of nitrogen increase the crop over mixed minerals enough to pay for its cost. Such an average result is of value to all, indicating, as it does, that farmers cannot afford to pay much for the nitrogen in commercial fertilizers until by experiment they have found it to be needed by their soil. And fertilizer manufacturers should learn by them to put in their goods more phosphoric acid and potash with less expensive nitrogeneous materials, as farmers, with but few exceptions, cannot afford to pay the high prices they are required to for nitrogen. Nitrogen as a fertilizer, in the form of ammonia or nitric acid, is not at our command. Its presence in the soil is essential for the growth of our crops, but it is absorbed from the air by the soil in nitric acid and ammonia. The decay of vegetable matter in the soil is also constantly adding to the supply, and the rains, which in hot, showery weather bring down large amounts of it, are also leaching it out of the soil in the form of nitric acid. Surely we cannot afford to pay dearly for such an unstable substance, which is continually coming and going in the water supply.

The great range of variation in the results obtained by

such experiments in different localities suggests the inquiry whether formulas for crops, which in the past have been so popular, should not more properly be designed for different soils rather than for different crops, as there appears to be a much greater variation in the constituents of plant food available in different soils than there is in the different amounts of these several constituents needed by different crops. Analysis of different brands of special fertilizers for the same crops, as well as different samples of the same name, show greater variation from the formula they profess to be made by than the formulas for different crops call for. Numerous instances are on record where these special manures have been applied, either through mistake or intentionally, to different crops from which they were intended with equally good results.

When I first commenced these experiments I was a believer in formulas for different crops, to be modified by the needs of the soil on which they were to be used, and for several years I compounded different materials for the different crops, leaving out, in part, such constituents as appeared to be most abundant in the soil, as indicated by these experiments, intending to grow the same crop continuously on the same land; but as I got more light on the subject my formulas for different crops approached more nearly to each other, until I finally abandoned all such attempts and now make one mixture for all crops, only using larger quantities for some crops than others, and applying the chemicals alone to such crops as they seem best adapted to, and stable manure to such as I think it will most benefit, endeavoring to fill the soil with all needed materials, and depend on a judicious rotation to meet the varying requirements of different crops.

I am adopting a rotation, consisting of cucumbers, for pickles, after a crop of early cut hay on run-out mowing, with a light dressing of stable manure, and about eight hundred pounds mixed mineral fertilizer, consisting of one part muriate of potash and two parts dissolved bone-black, with chemicals and hen manure mixed, applied in the hill. After the cucumbers are off, winter rye is sown and cut green the following spring for hay, in season to be followed with corn, either for fodder or to ripen. To the corn I apply only

chemical manures in the same proportions stated for cucumbers, and sow broadcast, with two hundred pounds in the hill. The corn is followed by potatoes or cabbage, which receive a good dressing of stable manure, seven or eight cords per acre, and six hundred pounds of mixed mineral fertilizers, in the drill, to be followed in the spring with a dressing of three hundred pounds chemicals and seeded with oats, clover and grass seed. I cannot afford to use my stable manure on corn or grain crops, but save it for vegetables, where its mechanical action, warming and lightening the soil, is of special value.

All my chemical fertilizers, except such as are needed for these small experiments, are mixed together in the barn early in spring, in the proportion of two hundred pounds dissolved bone-black and one hundred pounds muriate of potash, and such quantities as are needed are weighed up from the common pile when wanted. This mixture is such as at present seems to be best adapted to my wants, but in the future such changes will be made as from time to time these experiments seem to indicate are needed. I cannot better close this phase of my subject than by the following quotation from Prof. S. W. Johnson's report of the Connecticut Experiment Station for 1878: "Special manures for particular crops are in fact least heard of where agriculture is guided by the clearest light of science and the widest range of experience." Sulphate of potash has been claimed to be better for potatoes than muriate. To learn if it was so, in 1879 I applied, in addition to stable manure, eight pounds of sulphate of potash on a small plot of four square rods, and the same quantity of muriate of potash to an adjoining plot of the same size, and got exactly the same yield on each, with hardly any noticeable difference in quality. Both were excellent. In these general experiments I have used muriate for potatoes as well as other crops, and have always grown potatoes of superior quality with it, and such has been the unanimous testimony of these experiments reported to Prof. Atwater, which seems to indicate that muriate is, on most soils, equally as good and much cheaper. Many samples of potash sold as sulphate contain large quantities of muriate also. In two samples analyzed at the Con-

necticut Experiment Station in 1879, more than two-thirds of the potash was found to be muriate. At first I used to buy sulphate entirely for my potatoes in field culture; afterwards I bought one-half each, and last season I used muriate only, with equally good results and at less cost. To those intending to try similar experiments for themselves, a few words with regard to how to conduct them may not be out of place here. In the first place, parts of the farm which are the most impoverished, if of uniform condition, are the best for this purpose.

The plots should be staked out one rod wide and eight long, which will give one-twentieth of an acre to each, and should be all parallel to each other.

After the land is ploughed and harrowed across the plots, a chain should be drawn straight from stake to stake, between each plot, as a guide to sow the fertilizer by. The fertilizers having been properly mixed for each plot, with a little sawdust or earth added to the smallest quantities to make the bulk of them about equal to the largest, and if windy they should be moistened by sprinkling with water as mixed, to prevent their blowing away when sown. They should all be sown in the drill or broadcast, the thickest in the centre of the plots, without reaching quite to the edge, to avoid mixing with the adjoining plots. They should all be planted, hoed and harvested as nearly at the same time as possible, and carefully weighed and recorded. Do not put the fertilizers in the hill, for some of the materials will burn the seed more than others, and so vitiate the results.

Farmers of Massachusetts, you are asking, How can we keep the boys on the farm? If you would keep them there you must interest them in farming, and make it as attractive as other occupations. In nearly all business pursuits money is the principal attraction to the Yankee boy. The farmers' boys usually leave the farm because they think that there is more money to be made in other occupations. They see that in many cases farming does not pay as well as other kinds of business. But there really is no reason why it should not. It can be made to pay, and to pay well; but times are changing, new ways and methods are required to meet the changes made by time. The ways of a previous

generation may have been the right ways for them, but they do not meet the needs of to-day. Western competition has worked great changes in Eastern agriculture. Our business is to supply our local markets with such articles as they require, and for which they are willing to pay a fair price. Our soils, by unscientific management, have become impoverished, and in order to make farming remunerative we must restore them to their former productiveness. Now, if you would retain the boys at home, enter upon a series of experiments similar to those I have described, and learn by them the special needs of the soil of each of your farms, and with the knowledge so gained you can, at a comparatively small cost, restore them to their original productiveness and retain them there; and the boys, already interested in the farm by watching the experiments and a study of their lessons, as well as the increased profits of the farm, will be only too glad to remain on the paternal acres.

The Chairman. Gentlemen, you have listened attentively to this elaborate and well-written paper, and many of you, no doubt, have questions to ask relative to the topics discussed in it. Mr. Pierce will be ready to answer any questions which you may wish to ask.

Mr. Spaulding of Tewksbury. I should like to know the extent of the lecturer's farming; I should like to know the profit he makes yearly on his farming by using fertilizers.

Mr. Pierce. I have been farming, with the exception of two or three years, all my lifetime. I was born and brought up on a farm until I was twenty-one, when I left it and went to the city, hoping to get rich faster and easier. After subjecting myself to various vicissitudes, I returned to the farm with broken health, poorer in pocket than I left it, but with the firm conviction that I could restore my health, enjoy myself, and make as much or more money on the farm than I could in the city, and, commencing in that way on a run-down farm, which my father, who was in a feeble condition, — almost a cripple with rheumatism, — had neglected, selling only hay, I have made that farm support two families instead of one; and, if I have not got money in the bank to-day, I can safely say that I am making farming pay, and

my family is a good deal bigger than it was when I went on to the farm. The farm is worth a good many more dollars than it was then, and I am getting it in condition where it will support me well. The past year has been a very bad year; I have put in probably more than I can get out, but I have not lost anything. I bought large quantities of chemicals and many new tools; they are all there, and I am satisfied that, taking one year with another, I am making a success of farming. I claim that any young man who, with poor health, little money and a family, can take a run-down farm and make it support another family besides his own in comfort, is making a success of his business. We are too much inclined to judge of the profits of farming by a man's financial condition. If a man has poor health, if he has a large family, if he has much sickness, if he has a mortgage which, perhaps, in some instances is more than the farm is worth, on which he has to pay interest, — if he has any of these varying causes which are a drain on him, you should not say, because he does not make money under such circumstances, that he does not make his farm pay; but you should say it is because he works at a disadvantage. If his farm, as a farm, pays, he makes his business pay; although he may be owing a mortgage of several thousand dollars, and may not be able to lay up much.

Mr. Hillman. If I manure a field of ground that is in fair condition with say five cords of stable manure, spread upon the surface, and then add 800 pounds of a chemical fertilizer, spread also upon the surface, harrow it in thoroughly, and plant corn, how am I to give credit? What proportion should be given to the stable manure and what proportion to the chemicals?

Mr. Pierce. It has been my custom, in making my estimate of these experiments, to charge *half* of the stable manure to the first crop and *all* the chemicals. But this is a very difficult problem. As I have said to you, farming cannot be made an exact science, and you cannot figure these things out exactly; but I think that you are inclined to underestimate the value of the chemicals. I find that the chemicals which I use exert an influence for a number of years. Where I planted cucumbers this year and put fertilizers in

the hill this fall, after I had ploughed it, harrowed it, and sowed it with rye, which was about the time of the wet spell in October, there came on dry weather for a week or two, and in looking over that field I could pick out where every cucumber hill had been. There was an incrustation on the surface where these saline constituents of plant-food had by evaporation come to the surface and formed a little incrustation, looking like frost, and you could look across the field and distinguish where the rows of cucumbers were. The year before I did the same thing with that piece. I sowed it to rye, and last spring, when the rye started, a person standing in the road and looking across the field could see where the fertilizers had been applied. In that case, there was a little put in the hill and much more sowed broadcast.

Mr. HILLMAN. My question embodied as nearly as possible an exact statement of what I practised this last season, only I left in the centre of the field a strip upon which I sowed no chemicals. I was not able myself, and I could not find a man in the neighborhood who could discover the least difference between that strip upon which no chemicals were sown and the remainder of the field. Now, what are we to say in such a case as that?

Mr. SPAULDING. I hardly got my question answered. I want to know the profit in dollars and cents; whether the gentleman has kept an account, so that he can tell us the profit, in dollars and cents, of his farming?

Mr. PIERCE. I have kept such an account. I do not keep an account with every field every year, it is too laborious a process; but in the table of the second year's expenses, I have figured out for each plot the cost of a bushel of corn. I suppose the table will be published; I cannot make it intelligible to you unless it is put on the blackboard. But you will find in the table that I have given the cost of a bushel of corn as nearly as I could get at it. I kept an exact account of the labor that year, and the cost per bushel of the corn grown on each different plot. I have kept an account with corn, potatoes and cabbages. Last year I sold two hundred dollars' worth of cabbages from half an acre, as near as I can make out, and I kept as exact an account as I could. I have no doubt that I cleared one hundred dollars'

profit on that crop of cabbages, and I believe I can repeat that most seasons. This season my cabbage was not planted on favorable land and the drought affected it.

The SECRETARY. As this subject is to come up this afternoon in connection with the lecture by Mr. Cushman, who is to speak on the question, "How shall we fertilize our farms?" I would move that this discussion be postponed until after the reading of that paper. There are many here present who have come to hear Mr. Moore's paper, and join in the discussion of that.

The CHAIRMAN. You hear the motion of the Secretary, and undoubtedly see the propriety of acceding to it.

The motion to postpone was put and carried.

The CHAIRMAN. I now have the pleasure of introducing to you Mr. MOORE of Concord, who will speak to you on the subject of market gardening.

MARKET GARDENING.

BY. J. B. MOORE.

Mr. President and Gentlemen, — I propose to discuss the subject of market gardening in a general way, leaving to the skilful gardeners who are in attendance to describe the methods of cultivation of the various crops grown by them.

What is the value of market garden crops grown in Massachusetts, and is it an industry of sufficient importance to occupy the attention of this audience?

The census of the State for the year 1875 furnishes statistics of most of the crops grown by market gardeners. Some of the crops enumerated, such as beans and potatoes, perhaps, may be more properly called farm crops; but as potatoes are grown by market gardeners and farmers for an early crop, and as beans are sold very extensively in a green state, it would be fair to include one-half of their value in these estimates, and of the others I have endeavored to take only what may reasonably be called market garden crops. I find, as the results of these estimates, products valued at $3,503,231.00, and to this sum there should be added the value of certain crops not enumerated in the census report,

and also portions of crops sold from suburban gardens, which would swell the amount to $4,000,000.00; and, remember, that this census was taken eight years ago, and that there has been a very large increase in these products since that time.

From this showing I may assume that from its money value alone as an industry, that it is a subject worthy of your careful attention; and in another point of view its great importance in household economy, as furnishing a great variety of cheap, nutritious, health-giving food, must not by any means be overlooked in estimating its value to the public.

If we can, by consideration of this subject, devise any methods of culture, or make better known any old methods, by which we all can grow these crops cheaper and better, we shall have accomplished some good to the grower and to the consumer also.

There are many requisites necessary in gardening. The first, and it is a very important one, is the location, which should be near the market to be supplied, and there should be railroad and other facilities for quick and cheap transportation.

With such a location it is desirable to have a variety of soils; for early crops a sandy loam, with a slight inclination towards the south, will be found the best, but a heavier soil is suitable for the later crops.

All soils to grow vegetables well, or in their greatest perfection, must be well drained either naturally or artificially. It is impossible to grow fine vegetables in a soil saturated with stagnant water; the presence of water within a few inches of the surface of the land renders it unfit for this purpose; the water makes the soil cold; no tap-rooted plants can grow in it, and other plants can only wade through a miserable existence.

Having secured the proper soil, how shall it be worked so as to be in the best possible condition for the growth of plants? Deep tillage is one of the first things to be secured; this can be accomplished either by deep ploughing or by trenching. Ploughing is the usual method as trenching is more expensive.

Deep ploughing must be accompanied by heavy manuring,

for deep ploughing and light manuring will not return as large a crop as shallow ploughing and light manuring. What is heavy manuring? Market gardeners do not consider fifteen or twenty cords of manure, as it comes from the stable, too much for an acre; but farmers would call it extravagant waste to apply that quantity. The market gardener judges from his standpoint, and that is measured by the ability of the land to produce two or more crops in one season that will pay him a large return in money. The farmer estimates the value of one crop in a year, of hay or corn, to be fed, perhaps, to produce milk for which, this winter, he is graciously allowed to receive about thirty cents for a can of $8\frac{1}{2}$ quarts. Both are right; the one can afford the outlay, while the other cannot.

There are certain other requisites for the gardener in order to produce the best results, and among these must be reckoned not only an abundance of manure to fully carry the crops through the season, but much of this manure must be in such a condition as to be immediately available for the young plants, so that they may not be pinched at the critical time of their existence, but may have that food at hand that enables a plant to start and grow with vigor.

Plants so nourished will make larger and better specimens, will withstand disease and the ravages of insects, and will give a more profitable return for the labor and use of the land. Market gardeners generally use stable manure rather than commercial fertilizers, and situated as most of them are in regard to land, it is probably the best practice for them to adopt. Most of them cultivate from four to twenty acres each, and it is all under hoed crops. By this constant cropping the soil would in a few years become exhausted of a large portion of its vegetable matter, were it not returned by these heavy applications of stable manure. Then the mechanical effect of stable manure serves to loosen and lighten the soil, whereby it more readily receives the benefit of the air, rain, sun and dews.

I have thought that if a gardener had a few more acres of land than he wished to keep in hoed crops, he could grow crops of grass on some acres. These grass lots, when put under cultivation again, would be found to have acquired a

large amount of vegetable matter from the rotten sod, and would be in a better condition to grow almost any crop from that cause alone.

The preparation of the soil in the spring for the sowing of the seed for early crops must be attended to as soon as it is dry enough to work; everything should be ready for use when needed, the manure thrown over and made fine, seed ready, tools in order, teams and men ready to do the work promptly, so that when the proper time comes the manure can be applied, the land ploughed and the lumps broken, the surface made fine, and the seed sown before the land has become too dry for the seed to germinate. All garden plants are better for being hoed as soon as they are to be seen coming up through the soil; this, followed by frequent stirring keeps the surface in condition to get the full benefit of the sun, air and moisture, and causes plants to develop and grow much faster than they otherwise would; it also keeps down weeds. Weeds should never be allowed to make any headway. Stirring the soil about the plants on a hot day is one of the readiest means for their destruction, and at the same time it is beneficial to plant growth. Pure seed is even of more importance to the market gardener than to the farmer, while it is very important to both. The one grows crops for feeding to stock, the other to be sold in the market; a certain degree of coarseness may be allowed in the one case, but fine, smooth products become a necessity in the other. This can only be attained by using well-bred seed of the very best varieties, fixed in their habits by careful selection of specimens from which the seed has been grown, and which have been raised at such a distance from other varieties of the same species as to wholly prevent any admixture or crossing of the seed. And the gardener, so far as practicable, had better grow his own seed. When this cannot be done, it should be procured from the most reliable source, remembering that the price is but of small importance if it is well-bred, new and fresh:

As an illustration, take two plats of beets grown alongside of each other, one sown with the best strain of Dewing's or some other standard turnip-beet, the other with a mongrel, mixed turnip-beet seed, both being for winter

sales; the product of the first may be worth seventy-five cents to one dollar a bushel, while the latter would hardly be worth fifteen or twenty cents a bushel, and only suitable for cattle-feeding. The one would yield a profit, the other would prove a loss, and the cost of growing would be the same in both cases.

Much care should be exercised in planting the seed. Deep planting of some of the smaller seeds is often fatal, as they are likely to rot if planted deep with succeeding wet weather. If the surface of the ground is dry, a rolling, after sowing, with a light roller, will compact the surface and cause the seed to germinate better.

Straight rows are always desirable; you can run a cultivator or a scuffle hoe through the rows easier and nearer to the plants, and it is really no more work to sow or plant a straight row than a crooked one, and it looks better.

To carry on this business thoroughly requires the use of glass, either in the form of hot beds, cold frames, or houses for the winter growing of vegetables, such as cucumbers, tomatoes, radishes, lettuce and some other varieties, also for forwarding plants of various kinds to be planted out after danger of frosts is over. A large part of the plants for planting out are grown in frames, either hot beds or beds from which the heat has been spent for other crops.

The cost of sash, shutter, mat, fence, plank, for every sash 3 feet wide by 6 feet long is substantially $5. The number of sashes used by gardeners in the vicinity of Boston varies from 100 to 1,000 for each place, and in many instances large glass structures, heated by steam and hot water, for winter growing are used in addition to the frames.

Therefore it is evident that a large amount of capital is required not only for the real estate but for structures where vegetables are forced, and that these structures are of such material that they must necessarily rapidly decrease in value.

To realize the best results, one who is engaged in this business largely should have command of an abundance of water; and while it does not take the place of frequent rains, it often saves a crop for a few days until rain comes, and in forwarding crops, in such seasons as we have had for the last two years, and in the washing and cleaning of vegetables

for market, it is almost indispensable. For convenience in watering crops a comprehensive and convenient system of pipes should be laid through the fields, and if there is a head of a hundred or more feet it will be found more convenient for use. Droughts in Massachusetts do not appear to be the exception, and one of the great problems for the farmer to solve to-day is how to avoid the bad effects of a drought.

Our soils have by a course of injudicious cultivation, extending back over two hundred years, become partially exhausted, and only skill and high cultivation will bring them back to their original fertility, and the methods adopted by the market gardeners are in that direction. The aim of every cultivator of land, who has the true interest of the good old Commonwealth at heart, should be not only to secure a crop, but also to improve his land at the same time. And those statements of colossal farming in the western country, in the growing of wheat by the thousands of acres by Dalrymple and others, should not have any attraction for us, for at the best it is nothing but downright robbery, a depletion of the soil of its fertility, leaving nothing but sterility and ruin in its wake.

The persons engaged in market gardening, in my opinion, work harder and more hours in a day than any other class of farmers. The nature of their business compels them to do it, for a few days' delay even in getting their crops to market might change the result of a crop from a profit to a loss.

They work in all weathers, and even in spite of the weather. It has been said that they are so scrupulous that when they have promised a certain amount of produce for the next day, that no rain however hard ever prevented their gathering it in season for the time promised. Such labor is and ought to be well rewarded.

And in conclusion let me again call your attention to the great importance of this interest, not only for the value of its products, but also for the example it sets before the farmers of the higher cultivation of the soil, which means more thorough pulverization, more liberal manuring, promptness in putting the seeds and plants in at the right time, and

thoroughly cultivating and taking care of the crop during its growth.

This business is the higher art of cultivating the land, and it will be well for all our crops if we adopt the careful and thorough methods of these cultivators, for skill and brains will hereafter determine the success or failure of the farmer as well as of the gardener.

The CHAIRMAN. Capt. Moore has omitted to treat upon the subject of asparagus.

Mr. MOORE. Mr. Slade, I will say a few words to you about the cultivation of that vegetable. Asparagus, twenty-five years ago, was cultivated in an entirely different manner from what it is now. It was then grown in beds pretty near the surface of the ground. The crowns of the plants were uncovered by two furrows turned by the plough from the row, the open furrows filled with manure, and left in that way until the next spring. It involved a great deal of hand labor. How to grow asparagus in a cheaper way was left to some of us, myself among the others, to determine. I will describe the method in which it is usually grown in the vicinity of Concord, where one-half of all the asparagus raised in Massachusetts is grown. They usually select a sandy loam. It grows just about as well upon a poor, dry piece of land as it does anywhere; being planted so deep it avoids the droughts. The land is usually ploughed very deep. It is freed from stone to start with. On my own ground, the land is stirred to a depth of at least eighteen inches. This, of course, requires a strong team. If the soil falls back to the bottom of the furrow we do not care; we would just as lief have it down deep as anywhere else, because the roots of asparagus go deep. The ground is furrowed out in rows. Some plant it only three feet apart, but I think it is a better method to plant the rows four feet apart. Those rows are furrowed out, which leaves the land in ridges, with deep furrows. We intend to plant the asparagus about eight inches deep; that is, the crowns of the plants should be about eight inches below the surface after the ground has been levelled. I omitted to say, that the more manure you put on in preparing that land, the better it is; that is, the manure is ploughed under. It does not make much differ-

ence whether you plough it in or not; it will get down there in that loose soil; but it is usually ploughed in. At any rate, it would be covered in by the method of throwing this land up into ridges and making these furrows. After it is all furrowed out, it is planted with asparagus roots from one to two years old; some prefer one, and others two-year old plants. Those roots are planted, — depending upon the views of the planter, — from one foot to twenty inches apart in the row. If you plant them only one foot apart, you may realize a full crop a great deal quicker than if you planted them farther apart; but if you plant them eighteen or twenty inches apart, at the end of ten years your bed will be better than if it was planted thicker at first. These roots are covered about two inches deep. If they are planted in the spring they will come up through the soil, and when the weeds begin to start, the sides of those ridges are hoed down, a little at a time, which helps fill the furrow the plants are in, and by the first of August the land is usually levelled up so that you can run a cultivator between the rows. That is usually kept up through the season; that is, the weeds are destroyed and the ground kept loose. On my place, we manure it the next year, and plough in the manure about four inches deep. The stubble having been cleaned off, we go right over the whole bed with a swivel plough, with one horse, about four inches deep; it is then harrowed, and if there are any lumps, we run a brush harrow over it, and leave it in that way. The next year it is not customary to cut the asparagus; it goes on with the weeds kept out, without any other crop. The year afterwards we usually cut it until about the first of June — not cutting it too long that year; and if the bed is found to show any weakness or failure of the plants to throw up good, strong stalks, the quicker you stop cutting the better. The year afterwards it is cut during the full season, and from that year it keeps on increasing in the quantity produced up to eight or ten years from the time of planting. Now, I say what I believe, that no living man can afford to cultivate by the old method in competition with the method which I have described, because asparagus can be grown a great deal cheaper in that way.

QUESTION. I would like to inquire if you have had any trouble with the roots bunching and the plant getting out of the rows?

Mr. MOORE. If you examine the asparagus root carefully, you will find that the crown is inclined to spread in one way. It makes a little crown as wide as your two fingers, and so spreads in one way. If those roots are all laid in very carefully pointed one way, they will spread one way in the row; but of course it must be carefully done or it will run out. Beds usually, in the course of ten or twelve years, run over the ground. I do not know that that does much harm in an old bed. If the plough occasionally catches the crown of a plant and tears some of it up, it does no harm.

Mr. EVERETT. Is it essential to change the bed in which you have planted asparagus once in ten or fifteen years, or will it run generation after generation in the same spot of ground?

Mr. MOORE. I suppose it could be grown any length of time in the same piece of ground, but that will depend a good deal upon how it has been treated previously — whether it has been spoiled by too long cutting. But if it has been well handled, it will undoubtedly run fifteen years or more, and if it shows any signs of dying out, it is better to kill it out; and when you attempt to plough up a green asparagus bed, you have got a tough job before you.

QUESTION. How do you cut it?

Mr. MOORE. We cut it with what are called "asparagus knives," cutting it under the ground perhaps two inches. took a bed of asparagus a few years ago that had been cut up to the 4th of July, because we were going to kill it, and we cut it as long as we could get anything for the asparagus we were cutting, and put a dressing of manure on, ploughed it over, furrowed it about four feet apart, and planted it with sweet corn, run a cultivator both ways, and before the middle of September the asparagus was killed in that piece, without any trouble. We cut the sweet corn off and then seeded it down to grass, and it remained in grass, giving very good crops, for four or five years. Then I ploughed it up. I found I could plough it up easy enough,

but there was a foot of asparagus roots still in that bed after I ploughed it up. They were not rotted. It is no use to put them in the pig pen, for you cannot rot them; they are good for twenty-five years. A tussock will rot quicker than an asparagus root.

QUESTION. I would like to ask Mr. Moore if it is the practice to use salt on asparagus beds?

Mr. MOORE. In the town of Concord I think there is but one man who uses salt. Salt was formerly used very generally. I have used it at the rate of one hundred and fifty bushels to the acre. It does no good; in fact, it is an injury, because, if the application of salt makes one week's difference in the time of getting the vegetable into the market in the spring, it is a serious matter. I understand that the books have laid it down that asparagus is a marine plant and wants salt. You can rake up any of the old books treating of gardening back a hundred or a hundred and fifty years, and you will find salt laid down as absolutely necessary for asparagus. I had occasion at one time to look up, for the Massachusetts Horticultural Society, the history of asparagus. I went back as far as I could find anything in the English books — and some of them were more than a hundred years old — and I found in one of those very old books that the writer said that asparagus was a marine plant, growing on the coast of Spain (naming the particular locality on the Bay of Biscay, but the name has escaped my memory), where it was flooded at high water by the tides, and therefore, he argued, because salt did not kill it, that it was a marine plant. This writer went along pretty well until he got nearly through his statement, when he said that at this place which he mentioned they grew the largest and finest asparagus that was grown in Europe, and they applied two inches of night soil to it every year. I made up my mind that the real cause of the large size of the stalks was due to the night soil. I followed that history clear through the books, down to Peter Henderson, and I found that every one of them had copied that same thing. They did not write it from what they knew; they had made it up to order, as a good many books are made, and evidently they had copied it without giving the matter any attention or testing it to find

out whether salt does any good or not. I don't believe it does. It certainly does not with me, or with the asparagus grown in my neighborhood, and there are two hundred acres of it within two miles of my house. I don't think these growers can all be mistaken. I would not spend one cent for salt for anything, unless it is to cure meat.

Mr. Everett. In relation to the longevity of the asparagus bed, I will state a fact which comes within my own personal observation. The farm upon which I live was occupied, a hundred and twenty years ago, by an English officer by the name of Bowen: he was a half-pay captain in the British army. He bought that farm in the town of Princeton, where I now live, about a hundred and twenty-five years ago, and immediately planted an asparagus bed. It now stands very near the house in which I live, not more than fifteen feet from one end of it, and is about eighteen or twenty feet in one direction and twelve feet in the other. That asparagus bed has been growing with the greatest fertility from that period to this. The same identical roots have been in the ground about one hundred and twenty-five years, and I will defy you to find, in Concord or anywhere else, a more vigorous growth of asparagus than is found in that plot at the present time; we cut it generally until about the middle of June, — sometimes later and sometimes earlier. It grows up thick and rank, with only a small coating of manure once in perhaps three or four years. It is in a very good soil. I have sometimes taken a little boy, six or eight years old, when I have been playing with children around my premises, and thrown him right on the bed, and he will not sink down through it. That bed, as I say, has been growing one hundred and twenty-five years. I think that is a pretty good answer to the question as to the longevity of the asparagus.

Mr. Paul. I will inquire whether Mr. Moore has tried chemical fertilizers, and, if so, with what result?

Mr. Moore. I have tried chemicals to keep asparagus which has been run for four or five years. The result is not worth telling you, because I do not know what it is myself. Experiments of a year or two with fertilizers do not amount to anything; you have got to go through a long course of

years before it is worth while to undertake to draw any conclusions that will be of any great value.

Mr. Everett. In relation to salt, I had the same impression from books to which Capt. Moore has alluded, that asparagus belonged to the marine plants: that salt would materially increase the fertility and growth of it. I applied salt a good many years ago, but without the least perceptible effect; it seemed to do just as well without it as with it. I am sure it did no good.

Mr. ———. It seems to me that the gentleman has made too sweeping a statement here in regard to commercial fertilizers. From my own experience, I would advise every farmer to put all his neat stock manure on his farm, and then, in addition to this, use commercial fertilizers. These commercial fertilizers are in that state that your crop, when it first starts, will take them up, and then your neat stock manure will carry them forward. I was setting out half an acre of tomato plants a few years ago. I had ploughed in the quantity of manure that I thought would be sufficient for the crop; then I got a bag of guano, for which I paid three dollars; I put a small handful in each hill, and in two weeks from that time it was very easy to distinguish between the hills that had the guano and those that had none. I have no doubt that I got as much as fifty dollars from that guano, for which I paid three dollars.

Mr. Moore. I want to make a correction. The gentleman said I had made too sweeping a statement in regard to commercial fertilizers. I have not said a single word against them to-day. I believe I use more fertilizers in one year than the gentleman uses on his farm.

The Chairman. Is Mr. Rawson present? If so, will he please come forward and clear up this matter of fertilizers?

Mr. Rawson. I did not expect to be called up here to-day. I came solely to hear my friend Moore speak on the subject of market gardening. I expect the Chairman has got me up here to answer questions, more than anything else. Mr. Moore has gone over the subject of market gardening in a sort of light way, taking the headings, and I will perhaps follow in his steps a little, and coincide with some of his views.

As to the value of market garden crops in this State, by the census of 1865 the value was over three millions of dollars, I think; to-day it is double that.

It does not make so much difference now in regard to the location as it used to ten or fifteen years ago. Transportation now is so cheap, that if you are twenty miles from Boston or any other large market, you can get your vegetables there in an hour, so that a few miles makes but very little difference; but it makes a great difference with us who are situated near Boston, because our land costs us very dear and land a little further off does not cost so much. Ten acres can be bought for what we have to pay for one; and in some cases you can raise just as much on an acre as we can on this high cost land, and of course the difference in the cost of the land and in the taxes is a heavy item. If a man has plenty of money and can afford to buy his land near Boston, he will have some advantages, because he can get to Boston quicker, and by telephone he can get his orders from Boston and find out what the prices are, so as to get his products into market an hour and a half or two hours sooner.

I work my soil very deep and manure very heavily. I think it pays me to do it. If I had but little manure, I should put it on the top and work it as lightly as I thought the crop required, and take the consequences. My farm was carried on by my father for about thirty years, and I have had it for ten or twelve years, and I think it is getting a little used up. So last year I made up my mind to lay down five or six acres of the old place and hire another place of forty acres. I planted the old place just the same as ever I did; the dry weather came on, the crops did not come along as soon as I expected, and therefore I did not get a chance to lay it down, so I am just in the same condition now that I was a year ago; but I am going to do it just as soon as possible. I think it would be to the advantage of every market gardener to do so, as I know I can get a better crop on a new piece of ground, provided it is good land, the first and second years, than I can from old land. I took this new place, that had not been ploughed, I think, for thirty years, and cultivated the whole of it, breaking it up last fall, and although I did not raise but one crop on it, nearly every-

thing was good; it was of first-rate quality, but not quite so much in quantity, perhaps, as it would have been on land that had been worked for years. And speaking of that, I should mention irrigation, which I use to a considerable extent on this place. I had one piece of about seven acres in cauliflowers: the dry weather came on the first of August. Of course I did not know whether I would water it or not, but I had tried a little experiment in that line a year ago, on a little piece of cauliflower of about two acres, and found it paid me, so I got a steam pump and worked day and night for a week, pumping water on that piece of cauliflower. That was a paying experiment. I have used it also on my celery crop. Our town has water which they supply to parties for a certain sum, but they not being able to supply me, I put up, last year, works of my own, at an expense of about two thousand dollars, and this year I have paid that two thousand dollars from one crop, although it took me about three weeks, with four or five men; but I think I have got the two thousand dollars back from one crop this season, and I have got the works left.

Speaking of seed, that is a very important item, of course, in market gardening, and every market gardener should look out for his seed one year ahead. If he has got a good stock of his own, he is all right if he keeps growing his own seed; but if he has not a good stock, I would say, "Just look out for it the year before, and see that you get your seed of somebody who has a good stock." I raise most of my own seed, and in some cases I have a large quantity. I have quite a large quantity to sell this year, and expect to advertise them next spring.

Speaking of sash, our friend Moore says that the quantity of sash used by market gardeners varies from a hundred to a thousand. I do not know of but three that have over a thousand. We have about twenty-five hundred, and there are two others who have from thirteen hundred to fifteen hundred.

In regard to capital, I do not know how much capital I should tell a man he ought to have, but get all you can: the more you put in, the more money you will get out. I have got as much capital in it as almost anybody.

We plan to work about twelve hours a day, averaging from eleven to twelve. In the summer we commence at five and work until half-past six, going home to dinner. In the winter time, from about six o'clock until half-past five.

The item of labor with us is very important,— perhaps nearly half of our expense. It requires about thirty men to carry on my place in the summer, and twenty in the winter, so you will see that the labor expense is very great. Our labor costs from a dollar and a half to two dollars a day.

I will not speak of any particular crops, but this subject of irrigation, it seems to me, is a most important one in the line of market gardening at the present time, and I think it will not be long before the market gardeners who raise vegetables to any extent will all have steam pumps, for you can pump your water very much cheaper than any of you would think. It requires capital, of course, to get a boiler and steam pump, but a thousand dollars expended in that way is the best thousand dollars you can spend in a dry year. You can take your water from a pond or river or driven well. I think there are but a few places where wells cannot be driven and sufficient water for irrigation be obtained from them. There are two market gardeners in Arlington who are putting up quite extensive works for irrigation, and one of them gets his water from a pond, the other from driven wells.

Question. I would like to inquire of the gentleman if he has used a windmill?

Mr. Rawson. Yes, sir; I have two windmills and two steam pumps, and they all work well. Take them altogether, they pump considerable water. The windmill is good as far as it goes, but it does not go a great ways when the wind don't blow. Unless you have a very large reservoir, you cannot get sufficient water from a windmill, because sometimes I have seen three or four days in succession when there would not be a breath of wind. I have two windmills, and I have put two steam pumps under the windmills, and whenever the wind does not blow outside, we can make it blow inside, so that we can make the pumps work some way.

Question. What distance do you force the water?

Mr. Rawson. We run it two thousand feet through lead pipe.

Question. What is the size of your discharge pipe?

Mr. Rawson. Two and a half inch.

Mr. Paul. Do you use special fertilizers, and, if so, with what result?

Mr. Rawson. I have used special fertilizers, but I cannot tell you anything about the results. I use guano and ashes, but I use them in connection with so much stable manure that I cannot estimate their value. I use three or four hundred dollars' worth of fertilizers every year. I put them on the crops that I think they will help, and I think they do help them.

Mr. Paul. Is the object of using them to bring forward the plants to early maturity?

Mr. Rawson. Yes, sir, that is one object; and another is, when we manure in the spring at the rate of twenty or twenty-five cords to the acre, we want to get two crops from that piece of land, and when we put on the fertilizer, we think it may help along.

Question. Where do you market your crops?

Mr. Rawson. My markets are Boston and New York. I shall keep on in the old way of manuring with stable manure until I find something better, something as the old man did who run his farm by the moon.

Mr. Paul. I would like to ask the cost of stable manure at his place, that we who are distant from sources of supply may know how to compare the price with commercial fertilizers?

Mr. Rawson. I pay six dollars and a half a cord, delivered on my place. In the spring of the year I have to give seven dollars. Last year I was short of manure and bought about three hundred cords to put on the place I hired, and that is the price I paid for it. I used it all from the first of November until the first of the next May, under the hotbeds. This was fine manure, for which I paid six dollars and a half a cord.

Question. Partially rotted?

Mr. Rawson. Yes, sir; almost entirely rotted; it would shrink but very little.

Mr. Philbrick. Gentlemen, the subject of discussion this morning has been so ably treated and so thoroughly gone over that I have but very little in addition to say. I would add a few words to what has been said about irrigation. The two past years have been very dry ones, and have called this subject to our attention very emphatically. Mr. Rawson, who has just addressed you, has given excellent advice about this matter. There is hardly anything more imperatively needed now in gardening than provision against drought. It is the worst enemy we have to encounter. The methods of irrigation that are followed among the gardeners deserve a little fuller notice. Mr. Rawson has alluded to the steam pump and pipe as the method he uses. That method is generally used, and must be, on high land. The water must be distributed on uneven or high land in that manner. On land that is nearly level, or has but a slight declivity, water is distributed sometimes by ditches — furrows running alongside of the rows, and across. Celery is often watered in this way. A little furrow is run by the plough alongside of the row, and water is brought by whatever means can be obtained to the high end of the ditch and the ditch is run full of water. Then, in order to avoid the puddling of the soil, or hardening, baking, as it dries up, the earth is thrown directly back again before it has time to dry, and the roots in that way are moistened without baking the soil.

Another method of irrigation is practised on some of the low lands of Arlington. I am told, although I have not looked into it very closely — perhaps some of the Arlington men here can describe the method more fully than I can — I am told that the low lands of Arlington, in the neighborhood of Alewive Brook, have been drained. It was originally a peat meadow, and drains are put in there very near the surface, and very thickly together. Originally, the land lay only about two feet above the level of the water, and the water has very little flow from the pond down to tide-water. Those meadows, as I say, lay only about two feet above the permanent water level, so that it was impossible to drain them deeply, as is customary in laying tiles in other places. The tiles are usually put in three or four feet deep, but here the outlet would not admit of it, and the drains are

put in at a depth of eighteen inches or two feet. When drains are put in so near the surface as this, it is necessary to put them quite near together, or you do not drain the land thoroughly. If you put them two rods apart, which is customary where they are deep, the space between would be imperfectly irrigated: therefore the farmers there found it necessary to put their drains a less distance apart, and they drained their land in this way and planted with onions, celery and other crops that need considerable moisture. They found that in very dry seasons, when we had protracted droughts, and hot, dry wind for week after week, the surface of the soil became too dry. They wanted to water the celery, and they found that the most convenient way to water it was to obstruct the brook, the main ditch, and let the water back into the tiles. This year, I am told there was not water enough in the brook to do that, and they turned on the water from the public hydrants and filled the brook up in order to set the water back. This method might perhaps be applied in some other places. I am not aware that it has been anywhere else but in Arlington.

One other point about the hours of labor. I think American gardeners, as a rule, work harder and a greater number of hours than any other class of the community. They are obliged to do this to get their products in suitable condition for market and to market them properly. Most all marketmen who drive to Boston drive in the night. They leave home about six o'clock in the evening, arriving in Boston from nine to ten or eleven o'clock; put up their horses, and are on hand in the morning as soon as it is light enough to see the difference between a poor article and a good one, and oftentimes the buyers are about even before that, for the street is now lighted by the electric light, and they have to be on hand nearly all night to sell their load. That is in summer. In the winter time, we get a little more respite. We do not generally drive to market in the night; it is so cold things are apt to freeze. We therefore drive in the daytime; but still, we have got to be on the watch at night at home. Those of us who run greenhouses are likely to be caught with a northwest squall in the middle of the night and have our houses freeze, if we are not up and attending

to them. Although the business, when well managed, is profitable, more so than general farming, it is one which requires large capital, very close attention, and has pretty heavy risks in a dry season like the present.

Mr. Paul. I wish to ask how long should a pump be kept running in order to moisten the earth?

Mr. Philbrick. That depends entirely upon the character of the soil. There are some soils which will soak water readily, and there are others, more compact in their nature, which will soak it slowly. It is a matter of experiment. You must have water enough to soak the roots; if not, it is worse than nothing. When you have done that, it will last perhaps a week or ten days, depending upon how near the roots run to the surface. Roots that run deep may be watered less frequently. Another point is the use of water in bringing up seed. We have to sow seeds at all seasons of the year, and unless we have a shower directly after we sow, the seed will not come up. That was the case this year with spinach. The time when that is sown for a fall market is the latter part of August. This year, it was so dry that all the seed sown in August and September failed to germinate, unless artificially watered, until the first of October; then it was so late that it was very doubtful whether it would last during the winter. This crop is a very profitable one. I had a patch this season, about the size of this hall, which brought me fifty dollars. I might just as well have had an acre of it.

Mr. George Hill of Arlington. After the remarks of the gentleman who opened this discussion and what has been said by others, it seems as though but very little was left for me to say. I hardly know where to begin, and, if I begin, I am afraid I shall hardly know where to leave off. We are now going through a time different from what I have ever known before. For the last twenty years, since the war was ended, we have had in market gardening a great deal more competition than we ever had before, and the question is often asked whether we are going to stand up under it or not, whether we can go on and compete with the South. I hardly think I am able to answer that question, but I will say that, for one, I do not think it is any use to

give up; we must go on and compete; but we have got to turn over a new leaf in farming and market gardening; we have got to go into more thorough cultivation, and we have got to look deeper into the subject and understand it better. I think there is great improvement going on, and I think that eventually we shall come out and be able to compete with the South, although they have great advantages over us in climate; but their distance from markets is in our favor. We have obstacles in the way to overcome, and how we are to get round some of them I do not know. First, we have a very high valuation put upon our farms. It seems to be a valuation higher than is warranted, compared with other productive property — manufactories, railroads and all other industries seem to be taxed lower, although they have more immediate income, and it seems that the market gardens and farms that are near cities and villages are assessed too high. And I may say that we labor under two disadvantages there: first, in the taxation itself being too high; and then, secondly, if a young man undertakes to buy a farm, the valuation for taxation is so high that that is greatly against him. It seems to me all farmers are paying too much tax. The question is asked whether a young man can start now on a farm, run in debt for it, and work out of it? I should answer that question squarely, that a young man could not purchase a farm or market garden in the vicinity of a large city or village, at the price at which it is valued, and clear it; but if a young man has made up his mind that he is going to make that his business for life and going into it with a will, I think his chance is about as good in that as in any other business that he might undertake; but he must begin in a small way; he must understand his business. It has been thought that any man could take a farm and carry it on, whether he knew anything about it or not; that it was something very easily done; that a man could manage a farm if he couldn't do any thing else; but competition is so great now that a man must understand the business or he cannot make any money out of it. I was born and brought up on the farm where I live now in the town of Arlington. I can look around me in the town and find young men who apparently had good chances on farms, but who left those farms and went into other busi-

ness. I have heard of the fortunes that a great many have made in different parts of the country; some have gone West, some have gone to the cities, and some have come back; and there are but very few of those who had any means when they left home who have not found their money dwindling away, and many of them have come back with their means apparently very much reduced; and, looking over those who have stayed on the old places, I think they will compare favorably with those who have left the farms, as a general thing. I recollect in my neighborhood, where there used to be one very thrifty and flourishing farm, carried on by the same family for three or four generations. There were four sons on the farm; they were well educated, and thought that they could do business that would be more profitable than farming. Two went West, one South, and one went into Virginia, thinking that he understood farming and could carry on that business there. The old farm has recently been sold, and I doubt very much if there is a dollar of its value left. Now, when they left it, they were in as flourishing circumstances as any farmer's sons in the vicinity.

I have two sons on my farm. Sometimes they think they are not getting along fast enough. I tell them they are making two dollars where I was making one at their age. I tell them if they will stay on the farm, I think their prospects are just as good as those of the young men who have gone to the cities. Many of the young men who have gone to the cities have missed fortune, and I think if any young man who is a farmer's son will take a farm in the vicinity of a large city, and begin in a small way, he can work up, even if he has no assistance. He is on the sure road to a good living and some profit.

The gentleman who opened the discussion, and some of the gentlemen who followed him, made some remarks about seeds. That is a very important matter for the market gardener. There is an opening for a young man to establish himself as a seedsman. I do not know a man in Massachusetts who can properly be called a seedsman. There are plenty of men who raise seed, but there are few men upon whose seed you can really depend. I think it is more difficult to keep your seed pure than it is to raise thorough-

bred cattle. If a man has pure-blood stock, he can keep that stock pure more easily than he can keep his seed pure. I think there is one of the most promising openings for a young farmer, to go into the seed business.

There are many farmers who do not pay any attention to irrigation, or much attention to the nature of the land they cultivate, whether it is land that they can get a crop from or that they cannot get a crop from. Go through the western part of the State anywhere and you will find hundreds of acres under cultivation from which the farmer can never make a dollar, and upon that same farm you can find acres upon acres of land that would be sure to pay well. A man has got to study his farm, he has got to study his lands, he has got to know his crops and know what his farm will produce, and work the lands that will produce the crops; then I believe that any man who follows a good system of cultivation is sure of a good return for his labor.

Another thing. The farmers of this State never have had credit for what they have done for the towns. The towns are continually drawing the young men from the country. The State taxes the country for the benefit of the cities. What benefit do the hill townships get from the cities? A great many of our brightest boys leave for the city, all of them educated at the expense of the farmers. Every man knows that no boy can be educated in our schools for a small sum. For instance, in our town we pay $36 per capita for every boy that is educated in our schools; in my youth it was not more than four dollars per capita. See what an expense that is! The farming community should have credit for that, but we do not get any credit for it. That is one of the products of a farm, you might say, and the city gets the benefit of it.

There is another thing which works to the disadvantage of the young man in the country. Suppose a man has a farm, has it clear; he has a family of half a dozen children, perhaps. One of the boys stays at home, the others who go away from the farm want their money out of it, and oftentimes they do not favor the boy who remains on the farm any; he has to run in debt; the boys who leave the farm take that money and carry it away; the boy that stays at home has to mortgage the farm, and if he takes it, he takes it at the val-

uation, and is obliged to pay interest on the mortgage. The back country farms, in my opinion, have too high valuations placed upon them. I think the State has got to come to it, and the quicker the valuation comes down upon these poor farms within the reach of young men, the better. If it don't, we want to give them up entirely. It is sometimes said that the smartest boys, and all who have any spirit, leave the farm. I do not know where we should have been but for the boys who had not spirit enough to go away, as they say, or did not know enough to leave the farm. But some of those boys have managed to get along and get a good living, and when I look around me and see what has become of some of my early associates, I think it was fortunate for me that I did not know enough to leave the farm.

The CHAIRMAN. The practical experience that we are receiving from practical men makes this meeting very interesting. I would call on Mr. Rawson of Arlington.

Mr. RAWSON, Senior. Mr. President, I would like to say a few words, not confining myself to any particular topic. I heard Capt. Moore speak of asparagus and other vegetables, and the method of growing asparagus in old times, and said that it could not be done now as they did it then and make money. He went back twenty-five years. I set out a bed of asparagus thirty-eight years ago. I set my plants a foot deep, on very poor land, where they did well for a time, but after a while they came out on top of the ground, so that it was almost impossible to plough at all; and in undertaking to plough I pulled up the plants, and finally my bed was small, and difficult to cultivate, and I ploughed it up.

I am sorry that I do not see more young men here; most of those present are men of mature years. This hall ought to be full of young men; they are the men who need the experience of the old ones. But, as has been suggested, perhaps the young men leave the farms, and many of them have good reasons, in my judgment, for so doing; that is, they do not have the inducements held out to them by their fathers that they ought to have. My son, at the age of twenty, thought of leaving and going to Boston, thinking that he was going to better himself. I told him, "I will do better by you than you can do by going to Boston and tak-

ing the chances of the city." He knew that I was making a little something farming. I told him I would give him one-third of the income to come in with me, and he accepted my offer. In two years I gave him half of the profits. I finally sold him the farm, and he does not owe me a dollar for it to-day. If parents will take such means to keep their boys at home, I believe they can do it; but if they say, "I will give you ten dollars a month," when they can get twenty-five dollars in the city, they will go to the city; and I don't blame them. Parents crowd their boys; they do not give them a chance. Aid your boys all you can; if you can help them, do so. If you get your living out of it that is all you want.

Much has been said here about irrigation. The true way to irrigate, in my judgment, is by ditching, and letting the water soak through the ground. Top irrigation will not insure a crop; it will bring up the seeds, and keep them along a little while, but that is all. This year has been a very exceptional year. If farmers could have seen as far ahead as they can behind, they could have made money; but they cannot always do that, and we cannot make money every year. The great trouble with our methods of irrigation is that enough water is not put on to go down deep enough so but that the roots will come to the surface, and when they do, the scorching heat dries them up. Your plants will look vigorous in the morning, but before night they are drooping. Your roots are near the surface of the ground. In California they make their ditches six or eight feet wide; they fill them twice a week with water, and by that means raise a crop. It is not surface irrigation; they soak the land through. That is the proper way to irrigate. But the great question is, will it pay to irrigate and raise vegetables in that way for the Boston market? This year, which has been an exceptionally dry year, if you should go down to Boston market and go through it, you would not suspect that there was any such thing as a drought; you would think that there was an abundance of everything growing somewhere. Now, the question comes in, did the farmer and market gardener make money by the drought? I contend that the market gardener got more money out of the city of

Boston for his vegetables than he would have got if it had been wet; for if it had been wet, and everything had grown luxuriantly, as it started to grow, you could not have given away all the stuff that would have been raised this year. The market was hardly short of anything. I have driven to market for over thirty years. We used once in a while to say that we had got a corner on something; but I tell you that the corners are rounded off smooth now, and they are very hard to find. There is enough of everything all the time.

Mr. Moore talked about putting the manure upon the land in a condition for the little plant to feed upon it at once. In my judgment, the little plant when it is small does not want a great deal of this food. There is enough in almost any ordinary land to feed it until it begins to draw: then is the time that it wants food. I will state one case. I took a piece of this land that was ploughed over in the fall. I put on some slaughter-house manure. I spread it on the ground, and ploughed it in. I sowed radishes on that piece, and I never saw such a crop: they would measure fifteen inches in length. That didn't show that they wanted that extra food, for I will be bound to say that that ground had not had manure for five years. Then I planted sweet melons on the same piece. I hoed them the 13th day of July, when they were not more than four inches high. They took a start then and did better than any sweet melons I ever raised. That teaches me that the small plant does not want this very fine nutriment to work on. There is enough in any natural earth to feed the plant until it begins to draw; then it wants something to feed upon.

Mr. E. M. Pierce of Waltham. I am a market gardener and have succeeded in making a living up to the present time. I do not think that market gardening is anything like what it used to be. I think that the telephone and telegraph have rounded off the corners that Mr. Rawson spoke about thoroughly. If there are no onions in the country, and the farmers think they will hold them for a larger price, the dealers telegraph to Spain and in twenty days they will get a cargo in New York and the price will go down from $5 a barrel to $1.75. We thought the other day that there was a

little corner in spinach: it was selling for $1.50. They brought it in from some other State, and it is pretty hard to get forty cents for it to-day.

When I came in, there was a gentleman talking about fertilizers. I have not had any great experience with fertilizers. I never have received any benefit, that I know of, from anything but sulphate of ammonia. I buy some of that in the spring and apply it to spinach land, and I think it makes a return. I don't know any other fertilizer that I have ever seen any benefit from.

Mr. Pierce. A good many years ago, I took to market gardening, and, like the other Mr. Pierce that was here, I tried to do it scientifically. I thought that young men ought not to be old fogyish, and many is the evening I have sat, after a hard day's work, with Sir Humphry Davy's "Agricultural Chemistry" in my lap, fast asleep: it was not interesting enough to keep me awake. I was trying to get some points in farming, but I could never find out anything about farming except hard work. Later, I thought the farmers ought to be intellectual. I was the man who suggested to the Waltham Farmers' Club to divide their time, — 16 hours for work, 6 hours for sleep, 45 minutes for meals, and 15 minutes for mental improvement and feeding the hogs. (Laughter.) I have got past that: I have advanced, and the stand I take to-day for the farmer is, that he ought to have some other kind of business. (Laughter and applause.) Now, the successful farmer ought to have a pork-packing establishment, or some large leather business, or some office in court, or something where he can spend the money that he makes farming. (Laughter.) In coming here to address the meeting without any time to prepare themselves, men tell of some little experience that they have had, which perhaps is not a fact, although it may seem to be a fact to them. Mr. Rawson just spoke about the success which he had in raising radishes from slaughter-house manure. Well, I don't think Mr. Rawson would want folks to believe that that was the best stuff to raise radishes on every year, would you? Is not that an exception?

Mr. Rawson. I did not say so, did I?

Mr. Pierce. No. When an Arlington farmer gets up,

a man who is trying to make his living out of market gardening, I warrant he won't tell you anything that amounts to much. (Laughter and applause.)

Adjourned to afternoon.

Afternoon Session.

Mr. Slade called the meeting to order at two o'clock, and said: This afternoon you will listen to a lecture by Mr. Goodman of Lenox, on Jersey cattle.

JERSEY CATTLE IN AMERICA: THEIR PRESENT AND FUTURE.

BY RICHARD GOODMAN, JR.

Forty years ago there were in America a couple of hundred Jersey cattle. To-day there are twenty thousand. And to this twenty thousand head of "registered" Jerseys, we may add at least forty thousand for those entered in the American Jersey Herd-Book, and the pure but unrecorded, and the high grades. Roughly speaking, there may be said to be seventy-five thousand to one hundred thousand Jerseys in America to-day. Moreover, as these cattle are prolific breeders, come to maturity early, and live long, and as they, as a rule, are in the hands of careful and well-to-do owners, it is certain that the number of Jerseys in this country is increasing with great rapidity. And while Jersey cattle are very uniformly distributed over the country, Massachusetts has been, and is, one of the strongholds of their race. Such men as Thomas Motley began their importation forty years ago, and to-day thirty of the three hundred members of the American Jersey Cattle Club are from Massachusetts. There are probably two thousand registered Jerseys in this State which have cost, and would sell for, a million dollars; and the Herd-Book, unregistered, and high-grade Jerseys are worth as much more.

The bulk of the butter-making community in this State use Jersey milk; and more than three-quarters of the highest-priced butter is made from Jersey milk. Such being the

case, I trust that at this winter meeting of the Massachusetts State Board of Agriculture an honest investigation into the claims and merits of the breed of Jersey cattle may not be out of place.

It may be said with truth that the Jerseys are most highly prized by those who know them best. During the past forty years many cattle of this race have been owned simply as pets by wealthy men; but not a few have always been owned by intelligent and thrifty farmers. Yet it has been no easier to buy one of their good Jerseys from the hard-working farmer than from the rich man. This would seem to be practical proof that the Jersey has sterling merits, as well as what we may call artistic attractions. Paradoxical as it may seem, though these cattle have steadily increased in numbers, and in their general distribution, prices have increased even faster. Almost the youngest of my hearers can remember when a first-rate Jersey cow could be bought for $150; the lowest price for such an animal to-day is $350. Heifer calves could be bought a dozen years ago for $25 each; to-day they are legal tender in the States and Territories and in Canada, Upper and Lower, for a hundred dollars.

To compare the newer "butter breeds:" There are ten times as many Jerseys in this country as Guernseys, and there are four or five times as many Jerseys as there are Holsteins, yet the average price of the Jerseys is three times that of either of the other breeds. Out of twenty thousand Jerseys there are three hundred tests of fourteen pounds a week and over. At this rate we should have at least thirty tests for the Guernseys, and seventy-five for the Holsteins. I believe there are but three or four of the former, and of the latter not over twenty; and of the butter powers of Guernsey or Holstein grades we have heard little or nothing, while excellent tests for a week or more of Jersey grades appear in almost every issue of our agricultural press. And it is to the "grades" of a breed that we are to look for the proof of the real benefit or injury which a particular class of stock brings with its introduction to a country like this. For however numerous the "Herd-Book" animals of any race may be, they must nevertheless

be regarded only as the leaven with which the bulk of the stock of the farmers generally is to be improved and kept improving.

The bulk of the horned stock of the country is made up of animals of medium size and of a varied mixture of blood; namely, Devon and Durham of the old types, and of very varied degrees of excellence or worthlessness, as the case may be. As a "general purpose cow" she must "step down and out" at the same time with the "general purpose farmer," — both are rapidly, and rightly, becoming things of the past. I say "rightly" wholly from a financial point of view, not from the standpoint of a philanthropist or a philosopher. But not to go too far into metaphysics, what I desire to insist upon is: that in the struggle for existence and a decent competency to-day, it is necessary that men in almost every position in life should find out *what one thing they can do best*, and then, with the most appropriate tools, and with their whole mind bent on this one thing, DO IT! Such general principles apply as fully to the farmer as to any other worker in the community. He must specialize to live, and he must select his specialty wisely; and even then he must provide himself with appropriate tools and use them carefully and constantly to prosper.

This is true in the professions and in the merchant's and the manufacturer's departments. It is true of the farmer's life, and especially true in regard to farming in the New England States, and in none of the New England States more so than in Massachusetts.

Among the "special" branches of farming offering a certain and satisfactory reward to the Massachusetts farmer are milk-production, the raising and marketing of small fruits and the making of the better quality of butter. In the milk business, whether it is the production of that sold in bulk at 2 to 4 cents a quart or that of a better quality sent in bottles at 6 to 10 cents, there are sure and permanent profits.

But the milk producer must be within a moderate distance of his customers or of his railway station, and this station must be within a certain distance of the large cities. He is thus cut off from some of the most fertile farms of the State;

and there are other drawbacks to his calling besides this restriction.

In small fruits the present business is excellent and the outlook encouraging. As one illustration from many, take that from a recent issue of our bright and energetic weekly, "The New England Homestead." The farmer who is the subject of its sketch, went on to his present farm twenty years ago and tried sheep; dogs put a stop to that. He tried beef, but could not compete with the West. Then, instead of saying "farming don't pay," he said "this kind of farming don't pay, but there's a kind that does and I'll find it." He began to raise small fruits, — apples, strawberries. When he began to raise the latter, three hundred quarts were the product of his summer's work, and he thought these would "glut the market;" but his business grew steadily for fifteen years, and now his one thousand bushels a summer are sold promptly at profitable prices, with more asked for.

So much for milk and perishable fruits. A showing even more favorable for the Massachusetts "specialty" farmer can be made by an investigation of the "gilt-edged" butter business.

In the first place we must recognize the vast changes accomplished in Massachusetts and in the United States during the past forty years. I will not weary you with the number of miles of railroad built, or the number of acres of land brought under the plough, or the improvement in agricultural implements during this period. I simply want to remind some of my conservative hearers that it has not been a period of sleep nor idleness, — the period between 1843 and 1883, — for the actions if not the words of not a few Massachusetts farmers would seem to imply that no change in the conditions of their calling has been made. But, as proof to the contrary, take one example. In 1843 the New England farmer harvested four bushels of wheat a day: now the western farmer harvests one hundred and forty bushels a day.

The fertility of the western soil, the improvement in agricultural implements and the perfection of railroad transportation, have they made no change in the markets of Massachusetts? At last the conservative New England farmer was compelled to confess that in the matter of corn, oats and

wheat, a powerful rival had in some way arisen; but that any attack could or would be made upon his butter business was never by him a moment admitted; and so nine out of ten of our farmers jogged along, making butter in the most filthy and careless and unsystematic ways, wasting their own time and money and also that of their customers. Fortunately two rivals soon appeared: western factory butter and eastern oleomargarine. In regard to the former, cheap corn and co-operation have triumphed over "dairy belts" and thoroughbred stock; and now in Boston and New York markets the best western brands stand at the front of all packed butters. If not any better than the best of our packed butter, the western is more uniform and more abundant, and could be sold at a profit at yet lower prices. In regard to the oleomargarine, the skill and energy and systematized efforts of manufacturers have triumphed over intense prejudice and determined opposition and are now driving all of the low grades of butter out of our borders. I am not acquainted with this substitute for butter, but I can readily believe that it is more attractive in appearance, more agreeable to the taste and vastly more wholesome than the "cheap and nasty" butter it is now successfully driving out of the markets. From at least two points of view we should welcome oleomargarine: first, because it provides the poorer classes with a cheap form of food; and second, because it will make it absolutely necessary to produce good butter or give up butter making, and the community will be the gainer in either event. If, then, poor butter is driven out by oleomargarine and the better butter finds a formidable rival in that from western creameries, what shall we do with our splendid upland pastures, our rich mowings, our clear streams? I answer: use them for the production of the *best butter*. Poor butter, even if it sells, entails a positive loss upon the maker. The better class of packed butter hardly makes both ends meet. It is only in the manufacture of *fresh print, or roll, butter of the very best quality* that the dairymen of Massachusetts can do justice to their farms and secure for themselves a profitable occupation.

Let us enquire into the nature of this "fresh print or roll butter of the very best quality."

There is sold in Boston every week a thousand pounds of this fancy butter, and it brings seventy-five to eighty cents a pound; and there is a steady demand for twice as much as can be obtained. There is sold in New York two thousand pounds a week of this fancy butter, at from fifty cents to one dollar a pound, and the demand is three time as great as the supply. And in every city and every village of fair size in New England, there is a large and increasing demand for this fancy or "gilt-edged" butter.

What is this butter? It is the product, made in special and careful methods, of the milk of the Jersey cow. It is made in the first place from clean cows, fed on certain kinds of clean food, stabled in clean air, and provided with an abundance of clean water. The milk is set in clean utensils and in clean air. The cream is granulated and washed in the churn, worked thoroughly but carefully, salted very lightly, and delivered to the customers twice a week the year round. This butter is ready to be used when delivered, and it is not expected to remain good over three or four days.

I see some of my hearers shake the head and say, "butter that will not keep a week can't be good for much." Well, my friends, it is good for fifty to eighty cents a pound, and just as much of it as you can put upon the market! A roast of beef, a leg of mutton, a strawberry — each of these is to be eaten within two or three days after it is "ripe." The same is true of the best butter. Fresh meat is one thing, corned or "put down" meat is another thing. Fresh apples are one kind of food; dried apples become another. Grapes are one thing; raisins another. Some people prefer corned beef and cabbage boiled together in a strong, greasy mass; others prefer juicy roast beef and dry, mealy, snowy, boiled potatoes; and though the latter is a much more expensive dish than the former, no one nowadays will deny that the fresh-meat business is a vast and profitable and stable trade. The same statement may be made of fresh fruits, like the strawberry, for example.

Let us not forget that in the past forty years enormous changes in habits of life have taken place, and farmers should remember that luxurious habits of life have crept into almost all other classes of society more rapidly and more fully

than in their own. Just as truly as the richer classes in cities to-day use fresh meat three times a day, so do they demand fresh butter every three days. Just as they insist upon having their beef, mutton and poultry and game "just right,"—that is, kept in a certain temperature a certain length of time after killing,—so they insist that their butter shall be "just right," according to their views and taste; and they not only know what they want, but they are able and willing to pay for it.

The fresh-meat business hasn't driven out the corned and smoked beef business; they can both exist side by side. The fresh-fruit business has not driven out the trade in dried and canned and preserved fruits. The same is true of this "fresh butter" business. It stands side by side with the trade in "packed" or "put down" butter; but, for the dairyman, the former is much more profitable than the latter. And even if we brand this fresh Jersey butter as a "luxury," it is no reason that we should stand aloof from it as an unstable, even if a profitable, business; for certainly, no race of people to-day are more willing than are the Americans to exclaim with the young French nobleman, "Give me the luxuries of life and I will dispense with its necessaries!" It is as easy to sell the fancy brands of cigars at sixteen dollars a box as it is good flour at eight dollars a barrel; it is as easy to sell a roast of beef at twenty cents a pound, and the fillet at forty, as soup meat at seven and corned beef at ten; and the business of producing the former is quite as stable and much more profitable than the latter.

It may be a bad showing for the morals of the community, but it is not, I have said, with the morals or manners, but with the tongues and the pockets of the people we are dealing to-day.

It is to the large but unsatisfied demand for fresh fancy butter that I desire to call your attention. Either the demand for a butter of a rich, nutty flavor, high color and firm, waxy texture, has led to the introduction of the Jersey cow, or the peculiar product of the Jersey cow has educated the popular taste, and thus created its own market, Whichever view of the case be true, at all events the fact remains

that to-day Jersey butter is the fashionable butter in the most civilized portions of the world. It fetches the highest prices ever known, and the demand is greater than the supply.

The Jersey cow unites the minimum of body with the maximum of butter. She not only gives more butter than the cow of any other breed, but she gives it at less cost, and of a better quality than that produced by any other breed. *The Jersey is the most profitable butter-producer.* She is in the first place a cow of medium size. It is a disputed point as to whether a small cow requires any less food for the repairs of a matured body, but I incline to the belief that a cow weighing nine hundred pounds uses up less food in the support of the body than is required by one weighing twelve hundred pounds. At all events the smaller Jersey requires less food to develop her body than does the larger animal. But to return to their butter production. Jersey cows in my stables have made 2 lbs. of butter a day on 1 quart of cornmeal and 3 quarts of middlings, and 14 lbs. of hay, all dry, and in a barn so cold that the manure frequently froze solid. And on a moderate old pasture, and with no other food, I have had cows make $2\frac{1}{2}$ pounds a day. Mr. Boyd's Alderney made over 19 lbs. in 7 days on grass. Bomba made 3 lbs. a day, — four months from her second calf, — on 4 quarts middlings, 2 quarts cornmeal, and an October pasture of moderate quality. And I do not quote the foregoing instances as those of very extraordinary cases. They may be taken as fair samples of the better class of Jersey cows. I have collected numerous reports of half, three-quarters and seven-eighths bloods making two pounds of butter a day on similar feed. This, however, is looking at the race from only one point of view. It is important that we should see what cows of this breed can do on larger rations. Haynes's Bess made 24 lbs. 11 ozs. in 7 days. Value 2d made 25 lbs. in 7 days. Jersey Bell of Scituate made a like amount in the same time, and Nancy Lee made 26 lbs. in 7 days; and in this last case her feed was 4 quarts of corn, 6 of bran, and pasture. The Jersey is remarkable not only for daily and weekly *amount* of butter, but for *persistence*. Nancy Lee made 95 lbs.

in 31 days; Naoma made 95 lbs. 2 ozs. in 30 days; Mary Ann of St. Lamberts made 511 lbs. in 155 days; Pansy 1019 made over 600 lbs. in a year; Jersey Belle of Scituate over 700 in a year; Eurotas 778 lbs., and gave birth to a calf, in eleven months; Jersey Queen of Barnet made 850 lbs. in twelve months.

The above instances from a large number are given in support of the statement that the Jersey surpasses in amount of butter-yield all other breeds on a moderate and healthful ration, and responds beyond any other breed to increased rations.

We have said that there are twenty thousand registered and twice as many unregistered Jerseys in the country. The question may be asked, Why have we not more butter-yields recorded?

In the first place, I answer we have more tests in proportion to the number of our cattle than have any other even of the so-called butter breeds. There are twenty thousand registered Jerseys and three hundred tests of from fourteen pounds a week up to twenty-six; and we have a dozen tests for a month and half a dozen for a year. There are six thousand Holsteins in the country from whom we should have one hundred tests — we have hardly twenty: these are for one and two weeks only, none for a month and none for a year. Their milk records show great persistence, however, and no doubt we shall have numerous important additions to the present list of their tests.

Of the Guernsey cattle we will say there are two thousand in America. From these we should have thirty weekly tests: I have not heard of three, and we have none for a month or a year.

It should in this connection be borne in mind that the separate test of a cow for her butter, even for a week, is a matter of no little labor on a busy dairy or breeding farm; and tests for a month or a year really call for the outlay of considerable capital as well as labor.

Accurate butter tests for a year, however, are the true and only foundation of scientific breeding.

The Jersey not only makes more butter in a day, week, month, year; but she makes more in a lifetime; for she is

not only one of the longest-lived of all breeds, but she begins her work earlier than any breed. Jerseys drop their first calves at sixteen, eighteen, twenty and twenty-two months without showing any injury to the ultimate size or vigor of their bodies or reduction in their butter product, and the investigations of the leading breeders agree in considering it unsafe to allow one of this breed to go later than her twenty-second month before milking. Jerseys "hold out" in their milking periods with great persistency. Many good animals of this breed could be cited who have milked continuously for six or eight years, while producing at least one calf a twelve-month; and as a race they do not commonly go dry for a longer period than six weeks.

The Jersey bull possesses remarkable power in transmitting the characteristics of his race. No bull of any breed "nicks" better with our native stock; and no bull shows greater power in "grading up" the native race with all of the valuable characteristics of his own. A half-Jersey often gives the rich butter-yield of the pure blood, and the higher grades are almost certain to do so.

Jerseys and their grades are now to be found, and in considerable numbers, in nearly every part of the United States and in Upper and Lower Canada. In not one of these sections have they failed to adapt themselves to the climate and the feed. The little Jerseys have bearded the Short-horn lion in his very den; they flourish nowhere more vigorously than in Canada and Illinois. They are the favorite race of the Southern States. They are the bulwark of the dairy interest of New England.

Jersey milk is remarkable for its richness as it comes from the udder. The average for the cows of the United States is over thirteen quarts to a pound of butter. It takes but five, six and seven quarts of Jersey milk to make a pound of butter, as is shown in the tests of some of the leading animals of this breed. A selected herd in New York give an average of six quarts of milk to a pound of butter. From a working herd of sixty-five Jerseys, pure and high grade, in Connecticut, the average was eight quarts of milk to a pound of butter the year round and for several years. In another large herd in Massachusetts, eight to nine quarts in winter

and eight and a half to ten in summer. Another large herd in Massachusetts gives us a quart less to a pound of butter.

The butter globule is very large in the milk of the Jersey; in consequence of this the cream will rise quicker; which fact makes butter-making cheaper, and it also makes the butter better because the cream is exposed a shorter period of time to dust and undesirable odors and the floating germs of decay.

This large globule also causes the butter to come quicker in the churn; and this fact accounts to a considerable extent for the better texture of Jersey butter. The grain is also improved by the greater size of the globule permitting a better "granulation" and more perfect washing. And, thirdly, the larger globule permits of a more rapid and thorough salting and working.

That Jersey cream and butter have a yellower color is a pleasing but not an important fact, as the addition of annatto to butter is no more difficult or unreasonable than is the addition of salt — one pleases the sight and the other the taste, neither are important, and fashion at present demands a great deal of annatto and very little salt.

But the great characteristics of Jersey butter are flavor and firmness. Its freedom from a salvy texture in the heats of summer; its firm, dense, waxy quality; its crystalline fracture, place it beyond all butters of all breeds. Its flavor commends it to the public as much as its firmness. It has a rich, bright, nutty flavor which places it as far ahead of all other varieties of butter as butter in general is in advance of all other fats.

Moreover, Jerseys when crossed with the native stock, show the power of imparting this flavor and firmness as well as increasing the amount of their butter.

As to the prices of Jersey cattle: A registered cow, good in herself and with a good pedigree and a butter test of fifteen lbs. for a week on moderate feed, costs between $500 and $2,000; but a well-bred son of such a cow can very frequently be bought at birth for $10 to $25 and at four or five years for $50 to $100. Such a bull, for the owner of registered or grade Jerseys, is worth a great deal of money; the value of his services is incalculable, while the injury done

to a herd by a poor bull of the Jersey, or any other breed, is equally beyond computation. A few rough figures must suffice: The average butter product of cows in the United States may be put at 60 lbs. a year; that of cows selected for dairy purposes 100 lbs; while a grade Jersey herd in New York State gave an average per cow of 365½ lbs., and this in an unfavorable year. A herd of thirty pure Jerseys in Massachusetts gave 306 lbs., and a selected herd in New York 400 lbs. as an average for each cow for the year.

The cost of producing a pound of butter throughout the country, in private dairies, may be put at twenty cents, and the average price received for it, twenty-five cents. And this margin of five cents a pound is further reduced by the expense of marketing it. If by the purchase of a Jersey bull and greater care and cleanliness in the stable and milkmen we increase the cost per pound of our butter to twenty-five cents, but at the same time double the yield per cow in quantity and add from ten to twenty-five cents to each pound of butter we have to sell, it takes no great amount of figuring to give us the value of the Jersey blood; or, to put it in another way, where a good native will sell for from $35 to $55, a good grade Jersey will bring from $55 to $85. There is certainly profit in grading up with a Jersey bull, considering the increased value of the butter and the cows.

In regard to the details of the "handling" of the cows and their product: The animals should be stabled *above ground*. It is not possible to get fresh air enough about the cows in any form of cellar stable to ensure perfect milk. It is not enough to have the cattle in an above-ground stable, — there must be no manure whatever in any cellar beneath them. Nor is it safe to have grain or hay in the stable or above it.

The cow must be so stalled and fastened that she cannot walk forward into her manger and dung upon that portion of the platform upon which, when lying down, she rests her flank and udder. There is no need of a gutter behind her. If the platform is raised six or eight inches above the passageway behind, and if this fall of six or eight inches is just behind her heels and the passageway gypsumed and covered with dry sawdust or some other good absorbent, no gutter whatever will be necessary, and without the gutter the stable

can be kept much cleaner. Let the rear of the platform and nearly all of the passageway be whitened twice or three times a day with powdered gypsum, and then covered with an inch or so of dry hardwood or hemlock sawdust, and the cow will keep herself clean, the air in the stable will be kept pure, and the manure, solid and liquid, will be thoroughly saved.

I know of no better manner of fastening cows than by using the light but stiff and strong and easily fastened and unfastened wood stanchion of O. H. Robertson's, hung by three inches of chain above and below; Barnard's stanchion similarly made of iron or wood and fastened above and below by small, stiff iron elbows; and Robbin's running chain tie, with or without a neck strap. These three I have selected, out of hundreds investigated and experimented with, and the longer I use these the better I like them. They all work better if the manger slopes from all four sides to a space six by twenty inches at the bottom of the manger. These are inexpensive and convenient for the farmer, and clean and at the same time comfortable for the cow. These four elements are all absolutely necessary, and I know no other methods of fastening which unite these four requisites.

Give milking cows about seven pounds of hay three times a day, and two to three quarts of grain morning and evening, in the winter. Let this grain be cornmeal and wheat middlings, half and half by measurement. Let the hay be timothy, redtop, clover and orchard grass, all cut early, cured quickly and not allowed to heat. Let the corn be New England corn, if possible, and let both corn and wheat be perfectly fresh and sweet. Roots are not necessary, nor ensilage; if either are given see that no portion of them be rotten. In summer give rich old pasture, or a new pasture seeded with an appropriate mixture of at least a dozen varieties of grass. With either of these no grain; with a poor pasture give half rations of grain. Never feed cabbage, turnips, linseed meal, cotton-seed meal or brewer's grains. Rye or oats may be given at times for a change, but in very small quantities and well mixed with the other grain. Don't feed a Jersey cow too heartily, for she will either grow fat or get indigestion; in the former case she will give little butter, and in the latter the butter won't be good. Have a small, protected, warm,

dry pasture, in which the cows shall spend a good part of each not stormy day in the winter and spring, and all of every night during the summer and fall. This will keep the cows much healthier and the butter much better. It will also save the bad effects on cows and butter of too sudden change to the main pasture in spring. Give salt regularly and moderately. Let the water be that from a pure, running stream, and, if possible, from a stream that flows rapidly over stones and pebbles. Never use the milk of a very fresh or very stale cow; do not use the milk of a cow that is in season, or that has been run by boys or dogs, or that has been standing knee-deep in mud, or is in pain or ill-health. Card and brush the cow all over daily. Milk quickly, steadily, quietly and thoroughly. Do not sweep out the stable or brush the cows immediately before milking. Milk before cleaning up, or give the dust a chance to settle first. As soon as the milk-pail is filled take it out of the stable, and get it as soon as possible to the milk-room. Don't let the milker go into the milk-room; let him hand it to some person in the house to take in there. There are no milkmaids or milking machines as good as a man. Let the milk-room be above ground, and be filled with pure and constantly changing air. Set the milk in shallow, open pans, and let it be from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches deep. Let the temperature of the room be 60° morning, noon and night the year round. A milk-room which fulfils these conditions will cost from three hundred to thirteen hundred dollars, and will entail much annual expense for ice and coal; but it *can* be made, and, with small, round, shallow, open pans, produces *the only perfect butter*. But as these conditions are not within the reach of many dairies, it gives me pleasure to recommend the Ferguson creamer, which, at the cost of one hundred dollars, and a moderate outlay for coal and ice, gives a very near and extremely convenient approach to the perfect milk-room mentioned above.

The gilt-edged Jersey butter we speak of can be made in no way but by shallow, open setting at 60°. In no other way can the volatile, aromatic, flavoring oils be liberated, and the firm, waxy grain be preserved. Skim at twenty-four to thirty-six hours; ripen for twelve or twenty-four

hours at 60° ; churn at 55° to 65° ; granulate, and wash with cold brine. This can be done in a Blanchard churn. Salt with $\frac{1}{4}$ to $\frac{1}{3}$ oz. of the best salt; work with lever butter-worker; wrap the prints or rolls with wax paper or wet cambric ; transport to customers in tins, surrounded in summer by ice and in winter by an air chamber.

Arrange, if possible, to make more butter in the winter and spring than in the summer and fall. By distributing your work more uniformly throughout the year, you will make your profits greater and your labor less.

Dairymen of Massachusetts, you have at hand markets for your products equal to any in the world ; buildings, implements, pastures and water better than most any in the world. You can buy implements, seeds, fertilizers and grain cheaper than any other people, — are your cows or their products worthy of you or your advantages? Your State consumes fifty million pounds of butter annually : you make ten million pounds of this fifty, — you should make forty of the fifty. Instead of less than two hundred thousand cows, you should keep half a million ; and these cows, instead of producing less than one hundred pounds of butter each a year, should produce over two hundred. Your butter costs you twenty-five cents, and sells for twenty cents ; it ought to cost you twenty cents and sell for forty cents.

But to confine ourselves to the *higher* grades of butter : You now make and market, we will say, fifty thousand pounds a year at forty to eighty cents a pound ; you *should* make, and you *could* market, five hundred thousand pounds at from fifty to ninety cents a pound. You can make this advance by the use of Jersey bulls, and by the management of the cows and their product outlined in these remarks.

The Chairman. You have now an opportunity to propose any question to the lecturer.

Question. How long does it take you to churn?

Mr. Goodman. From three to forty minutes. Twenty minutes is the right time.

Question. What do you get for your butter?

Mr. Goodman. I have told you. Sixty cents a quart for

cream, seventy cents a pound for butter. I could crowd up on both of those prices, because I have been for two years twenty-five pounds or thirty quarts a week behind in my demands; and in the changes which I make in buying and selling my thoroughbred herd, I frequently have to cut down on the engagements I have made; but I have tried fairly and squarely to average the prices. In putting them up, as I have, from forty to eighty cents, it is a great deal nearer to eighty cents than forty.

QUESTION. I understood you to say that the best butter could not be got in deep setting. Does not Mr. Bowditch make good butter in deep setting?

Mr. GOODMAN. I never ate any of his butter. I have never had the pleasure of accepting his kindly invitation to break bread under his roof. His butter is made from Guernsey cows. I am not prepared to admit that that is in the category I have mentioned.

Mr. G. W. GODDARD of Greenville, N. H. Mr. Bowditch used the Harding system.

Mr. GOODMAN. I thought that had been superseded years ago. I thought that Mr. Cooley's system was far ahead of Harding's.

Mr. GODDARD. When I was at Mr. Bowditch's place, he had the Cooley creamer and the Harding system both in operation, and he did not think there was much difference. I have visited those concerns where the best butter is sold, for instance, Benton, Caverly & Co., in Boston, and they commend Mr. Bowditch's butter, and consider it as good butter as is made in New England

Mr. GOODMAN. I am very glad to be closely questioned on this matter, because it gives opportunity for discussion. I want to say that I am very glad, as a young man, to meet a young man in Massachusetts who is interested in dairying. An elderly gentleman said to me, as I was called to the platform, "It seems to me that only old men are engaged in the dairy business." I said to this elderly gentleman, that it was a melancholy fact that young men did not, as a rule, appear at these meetings, which meant that they did not take any interest in agriculture. I think it will be generally admitted that the young men go away from the farm if they

can. I think they make a great mistake in doing it. If young gentlemen do not like to stay on the farm because it is a hard life, here is a light and profitable employment for them.

Mr. Goddard. Mr. Goodman's remark does not apply to me. I am from New Hampshire.

Question. How do you put up your butter?

Mr. Goodman. We put it up in one pound and two pound rolls; never print it. We request our customers not to roll it into any form; it is worked just right when we send it to them. If they are not content to take it in that form, or make any complaint, they need not take it at all. We have plenty of people who are ready to take it.

Mr. Arthur A. Smith. I have been much interested in the lecture. I think it is time the men here who represent different breeds of cattle from the Jerseys should give their experience. I am well aware that the lecturer has a great advantage, but at the same time, none of us will say that the lecturer has made anything like aggressive movement upon any of the other herds; he has not laid himself open to any attack. There is one point that I think we ought to understand a little better. He spoke of filling the Jerseys up to their full capacity, and when they got so that they did not give the desired quality or quantity of butter to "bounce them." What does he mean by bouncing them?

Mr. Goodman. Butcher them. Don't waste money in attempting to fatten a cow.

Mr. Arthur A. Smith. We have Mr. Bowditch, we have Mr. Stone, and many other breeders here. Now let us have a friendly talk. This has been a sort of parlor concert to me, with these pet dolls held up for exhibition, that should be laid out on a mattress and fed with a spoon.

Mr. Hadwen. I think we better get through with the Jerseys before we commence on the other breed, with due regard for my friend over on my left. I want to say, as one who has handled Jerseys for more than twenty years, that I find very few things in the address to which I would take exception. I feel incapable of criticising such an address, and I feel, to use a word that the essayist has used frequently, it is "clean-cut" from beginning to end. There are only

one or two points wherein I should differ with the gentleman, and perhaps I should not on those points were I a butter maker; but I do believe that in feeding Jersey cattle we should not depart too far from the usage of the Island where they have been bred for long centuries, It is well known that the native food of the Jerseys is the most succulent grass that grows, and also a very liberal supply of the parsnip and carrot. I am among the number who believe that the Jerseys in this country cannot be kept up to their rich product of milk and butter without the free use of the parsnip and the carrot in their daily food. Consequently, I believe that Jersey cattle, in order to ensure the production of the best milk and the best butter should have good and nutritious food. My own practice is to feed two quarts of Indian meal, two quarts of oatmeal, and a peck of carrots, with good hay. With that, I will put the milk of the Jersey cow against any other cow in the world. I do not believe that you can make first-class milk in the winter without carrots.

Mr. Goodman. You are referring wholly to milk now, Mr. Hadwen?

Mr. Hadwen. Wholly to milk, not butter.

Mr. Goodman. Carrots will make your butter bitter, I think.

Mr. Hadwen. I refer to milk. I stated that I did not make butter, but I do make milk and cream. I know that I cannot make first-class milk from Jersey cattle in the winter without carrots and parsnips. I believe there are no cattle that are growing in the estimation of good butter makers in the country so fast as are the Jerseys, from the Atlantic, you may say, to the Pacific. They seem to adapt themselves to all sections of the country; not only from the Atlantic to the Pacific, but from the Canadas to the Gulf. I know that I have sent animals to almost every State in the Union and have never heard a bad report except from a gentleman in Arkansas, who wrote me that somebody had shot his Jersey calf, supposing it was a deer. (Laughter.) It was a dear shot for the man. But I have always believed that these Channel Islands cattle are to be the coming cattle for every one who makes good butter.

I fully agree with the essayist that the best cream can be

produced by shallow setting. No man could convince Mrs. Hadwen, who has taken the cream from Jersey milk for twenty years, that anything but shallow setting will give the best results. To make cream that is worth sixty cents a quart, the very best conditions are required, and among those, it is necessary that the milk should come in contact with nothing but pure air. I also fully concur with what the gentleman said in relation to the necessity of avoiding everything objectionable in the stable. If I understand the gentleman, he would not clean out the stables until after milking. I have made a mistake, perhaps, in that regard. I see the force of the argument, because my instructions are to clean the stable first, then the cows' udders are wiped carefully with a cloth, and then we milk. But I can conceive, although I never thought of it before, that in cleaning the stable you liberate the gases of the excrement, they go into the air and impregnate the milk, and consequently I have been instructed by that part of the address.

Mr. Tinkham of Vermont. Not long since I read a statement made by a gentleman who is called a great dairy authority, that the butter in these extraordinary yields, up to four hundred or five hundred pounds per year per cow, deteriorated in quality; that it had a sort of margarine quality, more like oleomargarine, and even worse; that it was lacking in flavor, and partook more of the nature of tallow than of butter. The statement was made by Mr. L. B. Arnold, at least it was attributed to him, that an extra quality of butter could not be made where the amounts named were yielded by the cow. I would like to know if Mr. Goodman has had any experience in that direction.

Mr. Goodman. I agree with Mr. Arnold. I look upon these excessive yields simply as indications of the characteristics of the Jerseys; what they can do under special circumstances. The fact that the excessive feed given to produce this very great yield injures the quality of the butter, — seems to me to run exactly parallel with what is admitted, that the flesh of show Short-horns, such as take the prizes at Chicago, is by no means as good as the flesh of Short-horns made on moderate rations. These large yields are simply indications of what the breed can do.

The CHAIRMAN. Gentlemen, according to the programme, the next thing to be brought before the meeting is a lecture by Mr. ELBRIDGE CUSHMAN of Lakeville, on the fertilization of our farms.

HOW SHALL WE FERTILIZE OUR FARMS?

BY ELBRIDGE CUSHMAN.

He who subsists by cropping the land without maintaining its fertility is no more worthy to be called a farmer than he who merely conducts the closing-out sales of another's goods is worthy of the name of merchant. Yet there are many whose system of farming runs on the easy decline of a down-hill grade in the old ruts and beaten paths of their fathers. Happily their number is diminishing, and with this generation they will pass from the stage; for it is gratifying to note the increasing interest, by the great body of our farmers, in adding to the productive power of the soils they cultivate. This is shown not only in practice but also in the interest taken in the reports of scientific investigations, and in the increasing demand for the latest knowledge and best proved means of fertilization. This desire for information, and this quick appreciation of approved though new methods, is the more important, in view of the fact that we are yearly meeting with unexpected competition and new obstacles.

The construction of lines of railways into vast regions of fertile lands, that in consequence are rapidly settled and pour eastward the abundant wealth of the virgin soils of the West, the scarcity and high price demanded for farm labor, the increasing varieties of insect pests, and other contrary influences, compel us to be wide awake and progressive. I wish to speak more particularly to those engaged in what is generally termed "common farming," or the production of the staple farm crops. We are often told that, with the competition of the West, there can be no profit for this class of farmers; that such should go where there are cheap and fertile lands that railways have made accessible to the markets of the world, and that our farming must be in the direction only of dairying, and the production of such perishable crops and fruits as are demanded by the mar-

kets of our cities and large towns. However this may be, with many another, I shall remain and pursue my calling among the scenes of my childhood and the institutions founded by our fathers. That we may be able to do so, meeting competition, improving our farms, and getting a fair return for our labor and capital, is the problem before us. In attempting to increase the productive powers of our farms, and in all contemplated improvements, we must bear in mind that there is a question of capital involved, and before commencing we must count the cost as well as estimate the gains. First, we must decide what shall be the feeding or producing power that we wish to attain, — what number of cattle shall the farm support? Having decided this, the next point should be to determine the least number of acres upon which this can be done. In England, it is not unusual for a farmer to keep as many cattle as he has acres under cultivation; but we need not cross the water for examples of high cultivation and great fertility. Many names might be mentioned in our own State of those who, by skilful and judicious management, not only sell large amounts of vegetables and fruit, but raise the fodder for as many cows or horses as they have acres under cultivation. That these cases are exceptional I grant, yet it is among this class of farmers who practice high and thorough cultivation, that we see success. We never have known such to complain that they had made their acres too fertile, or produced harvests too abundant for the markets; yet how many Massachusetts farmers there are who not only pay taxes upon large areas, the expense of fencing, and actually cultivate (as they call it) five acres for the maintenance of a single cow? This system results in loss and discouragement to the owner, and brings reproach upon his calling. Far better would it be for most of our farmers to narrow their bounds and contract their limits, tear away the fences that run over the rocky summits and around the hillsides of their outlying acres, set and encourage the growth of the great varieties of forest trees indigenous to such soils, and restore to nature's wilds that of which she never should have been deprived.

To gratify my delight in seeing crops grow, I have pur-

chased, and quite extensively, many of the varieties of commercial fertilizers offered in the market, and have made trial of most of the methods of fertilization recommended by the agricultural press. From many causes my experiments have been limited in extent and partial in results; yet I may say, I am convinced that we can never profitably develop the agricultural resources of our Commonwealth, or to any great extent the fertility of our farms, until more cattle and sheep are kept and fattened within our borders.

The market gardener, whose acres lie near some city or large town, where stable manure can be purchased cheaply and hauled at convenient seasons, may find it economy to furnish plant-food in that form. But for the great body of common farmers, producing grain and the grasses, if their acres are ever clothed with a greener verdure, it must be done, not by commercial fertilizers or by city manure, but rather by the flocks and herds raised upon them. It may be asked, Should farmers be advised to increase their stock beyond the immediate carrying power of their farms with this view?

If they are willing to safely invest their capital in their own vocation, and wish to improve their lands, make more of life and magnify their calling, I should answer yes.

Having decided the kind and amount of stock that your farm ought to keep, then put it on your land. The question will arise, How shall this increase of stock be housed, and wherewithal shall they be fed?

A few years ago our country was agitated by the perplexing question of the resumption of specie payment, when a wise journalist urged that the way to resume was to *resume*. And a corresponding answer might be given to the query before us, viz.: The way to keep stock is to keep stock. And it is only by adopting such a method that we shall properly stock our farms, and see these lowing herds and bleating flocks upon our acres and realize their profits in our balance sheets. These changes may be radical or gradual, as best suits the means and inclinations of the owner. When additional shelter is to be provided for fodder or for stock, remember that unless you possess ample means to gratify a taste for architecture, build only for comfort and utility.

And further, if increased numbers demand a supply of provender beyond the present production of the farm, the issue must be met both for the near and remote future. If the lands are in an exhausted condition, or, perchance, it may be that the cash productions sold from the farm are of such a nature as to draw heavily upon the fertility of the soil; in that case fertilization must be supplied by purchase and brought upon the farm. The kinds and amount that it may be most profitable for the farmer to purchase and use, is without doubt the most perplexing question he meets in the whole scope of his business.

To decide these questions understandingly one must avail himself of the results obtained at our experiment station, the knowledge diffused by the agricultural press and "Farmer's Institutes;" he must be an earnest student of the hidden things of nature, and he must have such a love for his calling as will induce him to conduct many experiments with the closest personal observation. When all is done, he may well call to mind the dying words of that great philosopher who discovered the laws of gravitation: — that he had but strayed upon the verge of the boundless ocean of knowledge and gathered a few shells and pebbles from its shores.

Agricultural chemistry has taught us that of the twenty or more different elements that enter into the vegetable and animal structure, all but *three* are found almost everywhere in an abundance. These three elements in varied proportions and different compounds are found alike in our haymows, our grain-bins and in our manure heaps, also in the honest brands of commercial fertilizers. Then it will follow that as we may add to our store of either of these we shall in like proportion increase the fertility of our farms. But the perplexing question is constantly before us, in what form can they be bought the cheapest.

Notwithstanding the legislation for the protection of the honest manufacturer, as well as the purchaser, nevertheless the common farmer feels that in the purchase of the many varieties of commercial manures he is not "master of the situation." Influenced by these considerations, we have advised farmers to keep stock or make their own fertilizers as much as possible, to buy grain to be fed out to animals

rather than plant-food; yet, if called upon, I should be compelled to plead guilty to not always putting in practice my own theories, for I do purchase plant-food for immediate use. For several years I have bought about twenty-five cords of stable manure annually; a large proportion comes from Boston and costs me eight dollars per cord, delivered on my farm. It is not always of the best quality, yet I consider it as cheap as any fertilizer in the market, and it comes nearer in kind and quality to that made in my own barn cellar. I am often asked, Does it pay to buy Boston manure? or, Can we get our money, paid for any fertilizer, back again? My answer is: I do it. I know that farming without ample manure from some source is a failure; my experiments in that line have been conclusive. It is our business to purchase it in one form and sell it in another. With equal reason might the manufacturer expect to sell his goods without the purchase of the raw material, as for the farmer to think of selling the products of his soil without returning their equivalent. In a cord of good manure, free from foreign substances, we get the results of about two tons of hay, together with the grain fed, less waste and growth; and if judiciously applied, the ground that receives this manure will yield these equivalents with interest. The purchase of stable manure is impracticable on many farms of our State. For the improvement of such, commercial fertilizers have been looked upon as the only means. Now, while I have known men to become wealthy by the manufacture and sale of these fertilizers, I have yet to learn of the common farmer who has made much money by their use. I wish to be clearly understood upon this point. I neither condemn the goods nor the men engaged in their manufacture and sale; that there are many brands that are just what they purport to be, I have no doubt, and no intelligent farmer at this day would entirely discard their use or deny their usefulness. What I would say is, I believe that the plant-food they contain can be purchased cheaper in another form; for at the price for which they are sold there can be but little margin for profit in the production of the common field crops.

We are compelled to pay too much for the compounding. Again, we may be buying elements and applying them to

soils that the crop does not want and cannot assimilate, or perhaps the soil may already possess them in abundance. In feeding an animal we first endeavor to ascertain what it requires, and if we have sufficient quantities in our barns, we do not pay a large profit on some *perfect food*, but rather, if we find we are wanting in some particular kind, we purchase that alone, and not mixed with several others that we do not want or already have. Farmers are often imposed upon in this matter on account of their inability to tell what they have in excess, or the element of which they stand in need. It is a safe rule, however, not to buy until we know what we want, and then to know what we are buying. And of all the varieties of plant-food in the market, there is none the qualities of which the common farmer *should* be a better judge of than stable manure. When it is expedient to buy chemical fertilizers it will be well to bear in mind that however bulky they may be, or whatever may be their color or odor, their value depends practically upon the availability and solubility of three elements in their compound, one of which is nitrogen, the most costly of the three. I have been at a loss to learn how the common farmer can conduct any experiments with this element alone that can result in any considerable advantage. We are told that in its pure form it is colorless and odorless; neither are the "doctors" fully agreed upon just how it enters the plant structure. It cannot be handled unless confined in some powerful base, and then we are at a loss where to place it to make it most available.

I have decided not to invest largely in this shy element until we are better acquainted, getting what I can, however, from stable manure and cotton-seed meal, both of which are rich in nitrogen. The purely nitrogeneous manures are not considered as essential as formerly, excepting where an excessive leaf development is desired.

Another of the three wanting elements, phosphoric acid, may be obtained from ground bone, or the phosphatic rocks, which are composed of the bones and teeth of prehistoric animals.

Nearly all of this rock quarried in Canada, and about three-fourths taken from the South Carolina beds, is exported

to England. We can purchase the bone or the pulverized rock nearly as cheap as it is bought by the manufacturer of fertilizers.

The last of the three elements to be purchased is potash. This may be bought in the form of wood ashes or the potash salts. It requires little knowledge of chemistry to go into the market and purchase fine ground bone, or phosphatic rock, wood ashes or muriate of potash; then any farmer can mix them on his barn floor, and use them according to his judgment of his soil and the crop to be grown. This judgment must be formed from experiments in the different fields of the farm, applying exact quantities of the fertilizers to measured plots, and carefully noting the results upon a variety of crops. But if we apply more of either of the elements named than are demanded for the immediate crop grown, they will not take to themselves wings and fly away, but will remain a sure investment, ready to respond to future drafts. But in our practice, it should ever be borne in mind that these fertilizers should be made supplementary to the barn-yard manure rather than a substitute for it.

The large consumption of English hay in our cities and large towns has given it a commercial value in excess of its comparative nutritive value; so, in my practice, I have considered it a profitable crop to sell, and should not buy it to feed to young stock, but should purchase corn stover and hay of the cheaper grades, making up the requisite ration with corn and cotton-seed meal. I know of a company manufacturing a fertilizer sold for $40.00 and $42.00 per ton that is using vessel loads of cotton-seed meal that is used in its composition. Is not this a hint to the farmers to buy the meal for $30.00 or less per ton, utilize its milk and fat-producing qualities, and still retain nearly all its manurial value upon the farm? He who buys and judiciously feeds corn or cotton-seed meal, especially the latter, will have a heap of the very best manure, worth many tons of any fertilizer in the market. I believe it is possible to select a stock of cattle and swine, and so care for them that they shall return to their owner a fair cash value for all they eat, leaving the manure for the cost of care and incidentals.

In the average year, with the means we have at hand,

there need be hardly any limit to the amount of corn fodder produced; so the amount of stock kept and manure made will be governed only by the farmer's space, capital and enterprise. Such being the case, there can be no question but that the most economical method to be pursued in enriching our soils is by stock-raising and stock-feeding.

The kinds of stock to be kept, the manner of feeding, whether we shall produce for the dairy or the shambles are each inviting topics that have been ably discussed at former meetings of this Board. But in passing allow me to suggest that whatever we feed, whether plants or animals, feed with a liberal hand. Many men cherish the belief that there must be some magical way of producing large crops by other than the simple means I have detailed; they have been impatient with this Board that they have not ere this issued a pamphlet filled with recipes for the production of this or that crop on any kind of soil. Too many have been slow to learn that the laws governing growth in the animal are equally applicable to the vegetable kingdom. Some have claimed that in their farm practice they have actually made exhausted lands fertile by the mere turning under of green crops without the application of manure in any other form. However much I may respect the experience of practical men, I must say that my farming on this line has not been attended with flattering results, and I have been at a loss to learn the kind, amount and source of such fertilization that was not derived from the soil in the production of the crop turned under.

In short it has seemed to me like feeding bacon to the hogs, or pursuing the policy of the woman who fed chopped boiled eggs to make her hens lay.

Some claim that the building of silos and the feeding of ensilage will increase the fertility of the farm. In the working of this system, I have had no experience and little opportunity for observation, so I will not utter a single disparaging word. I consider that the economy of storing and feeding by this method is as yet an open question. Many believe that great additions may be made to our resources by composting scanty quantities of manure with muck and earth. Some I have known who seemed to delight in the use of the shovel, to be possessed with the belief that if they put one

shovelful of meadow muck with another of dark-colored loam and the two mixed with one of manure, they will have three shovelfuls of manure, equal in value to the last. Let us not deceive ourselves; something cannot be derived from nothing.

We may work over and manipulate the substances on our farms as much as we choose, but we can no more make one particle of plant-food than we can add a cubit to our stature. Gather all the refuse that accumulates and save it with the utmost care; neither should the smallest amount of liquid manure be allowed to run to waste for the want of a proper absorbent. To this end it may be economy to cart soil or muck thrown from the ditches to the yards and barn cellars. But I have been forced to believe that many times the farmer gets small returns for the unsightly holes in his low lands, dug merely to get muck for compost. As a matter of ease and economy I take my manure as soon as convenient to the fields where it is to be applied and there spend my labor composting it with the first few inches of the surface soil. By this method we not only call to our aid the newly invented pulverizing machinery, but we have the influence of the sun's rays, together with all the atmospheric and aqueous influences.

On many farms there are waste low lands producing only bushes and coarse grasses that when properly treated will be found abounding in the rich accumulation of centuries, waiting only for the intelligent outlay of capital. Such acres need draining and cultivating.

I have been led to go even lower down into the very bogs and marshes. And it has been with no little degree of satisfaction that I have the two past winters driven choice loads of hay to market that grew on bottom land where but two years before I was compelled to carry off the coarse and inferior yield upon hay poles.

In reclaiming such land ample provision must be made for the speedy escape of all water, both from covered drains and ditches, and the utmost care must be exercised to secure a proper arrangement as well as uniform inclination of all tiles and drains.

Before seeding, the ground must be properly graded that water shall not stand in low places, and all species of wild

grasses and coarse herbage should be eradicated, when it should be well fertilized to give the tender grass-plants a vigorous start-off, after which a small yearly outlay will ensure two cuttings of good hay annually.

Such acres will not only be a source of profit, but they will be the farmer's pride, always to be looked upon with a loving eye.

But while it is well to have a few acres of this low or interval land, producing hay either for home consumption or a cash product of the farm, let us not overlook the acres that lie on the sunny slopes, perchance it may be near at home, close to the barn, acres that never yet have had the opportunity of responding to thorough cultivation and high manuring. I believe the possibilities of such an acre, adapted to the cultivation of almost all the crops grown in our climate, has never yet been fully told.

But however liberally we may manure we must not expect to reach the limits of fertility in a single year. Time is required to so incorporate all the particles of plant-food in the soil that the best results may be obtained with all varieties of crops.

I have seen the site of an old homestead, torn down and deserted for more than twenty years, yet the limits of the old kitchen garden could be distinctly traced, not alone by the adjacent tansy bed, the lilac hedge, and the lily's modest growth, but by the richer verdure of the grasses.

Having spoken of some of the means by which the fertility of our farms may be maintained and increased, allow us a moment in recapitulation.

Keep more stock, either cattle, sheep or swine, or, if circumstances are favorable, all three. Keep them better than ever before. Buy cotton-seed meal, cornmeal, fodder corn and swale hay. In purchasing feed for other kinds of stock we must be governed by their varied conditions; always, however, feeding such kinds and quantities as will be keenly relished and thoroughly digested.

If fertilizers are to be bought, buy good stable manure, fine ground bone, good hard-wood ashes and muriate of potash. And when the honest manufacturer will sell these elements compounded as cheaply as the farmer can purchase

and compound them himself, *then* it may do to buy still more largely of commercial fertilizers. But after all expenditures in this direction, we must improve our farms all we can by thorough tillage, watchful and untiring labor, until the end shall come or the ideal shall have been fully realized.

I know that there are many who will ask, Are not these things for the favored few? those spending the income of a large inheritance, or the profits of the counting-room and manufactory. Is it the part of wisdom for him who "earns his bread by the sweat of his brow" to make all these outlays here? Is there not somewhere a more favored spot? To the farmers of the Old Bay State I would say I believe "our lines have fallen in pleasant places." We know there are soils that do not require fertilizing for the immediate production of crops. But when all the advantages are weighed, we know of no better country than our State for a farmer or a farmer's home.

The products of our soil have not to be transported a thousand miles. Manufacturing and trade are ever creating an increasing demand for all our products at our own doors.

But a few years since it was loudly proclaimed that corn could not be profitably raised in Massachusetts, that it could be transported more cheaply from the fertile West, but by many well-tested experiments in all parts of our State, it has been shown beyond a question that on the warm and easy lands it may be produced for a sum not exceeding the cost of transportation.

So the wiseacres of to-day tell us that beef and the products of the dairy can be produced only at a loss. Without detaining you with details, suffice it to say that in my experience as a producer of milk for the Boston market, I have learned that by vigilance and care in the production, combined with co-operative effort in the transportation and sale, even with all the drawbacks incidental to the trade, milk can be produced without loss, although large profits flow in channels *not* leading to the farmer's pockets.

And so also in the production of beef. I believe that a bright day is about to dawn upon those engaged in that branch of husbandry, — the growing demand for choice beef,

the increased facilities for its transportation on the hoof as well as in the carcass. The time is not far distant when we may again look for a heavy profit in fattening steers with the surplus corn of the West and the cotton-seed of the South, and add to the fertility of our lands in doing so. And where can there be a more fitting place for the development of a healthy growth, — for flesh and for fat, — than in the invigorating air and by the pure waters of Massachusetts. And while we maintain our rank among the manufacturers of the world, and have an ever-growing home market, we need have no fear of overdoing this branch of our husbandry.

So, while the farmers of the great West are customers for the fabrics and wares of Massachusetts, let us in exchange take their corn and their steers, and by cheap transportation lines turn to our advantage what had seemingly been our great disadvantage, and in the comparative leisure of the winter months do the feeding and the fattening within our own barns, — thus not only furnish food for the workers and the artisans in all our varied industries, but at the same time, in the very cheapest manner possible, increase the fertility of our farms.

(Mr. John B. Moore of Concord, in the Chair.)

The Chairman. Gentlemen, you will remember that the discussion upon Mr. Pierce's paper was stopped this morning to make way for something else, with the suggestion that it could be renewed this afternoon in connection with this matter to which we have just listened. I hope there will be a discussion on this paper and a continuation of that which was broken off this morning. I suppose Mr. Pierce is in the room, and here is Mr. Cushman ready to answer any questions which you choose to ask him upon his lecture.

Mr. Ware. I have listened to both of these papers with a great deal of interest, and they are profitable, both of them. The commercial fertilizers that have been spread abroad over the State, over New England, and over the whole country these last few years, have excited a great deal of interest in the use of those articles and in the discussion of them, and many farmers have come to the conclusion that

they cannot get along without the use of them. They are profitable to a certain extent, particularly when used in the manner which has been indicated by the two essayists. You will remember that Mr. Pierce this morning advocated the use of them quite freely, and stated that he had found them profitable in his own experience; but he also urged the importance of farmers studying for themselves the condition of their soils, and buying the materials in the market and mixing them themselves, instead of buying the special fertilizers. I was very much interested in one remark that Mr. Pierce made, which was this: he said that in estimating the value of these fertilizers and the cost of the product from them, where he used barn manure he charged one half to the crop and the other half he credited to the land, while in the case of commercial fertilizers he charged the whole amount to the crop. There is a great deal of meaning to that. I judge that Mr. Pierce has discovered the secret of the use of commercial fertilizers, as I have myself. I think they may be of value in certain ways, to eke out the manures required for special crops, but I claim that no farmer can afford to depend upon commercial fertilizers as his source of fertilization. Why? Mr. Pierce indicated the reason why, although he did not state it so plainly as I wish he had. Commercial fertilizers have not the lasting qualities of barnyard manure. They may do for the present, to get over a difficulty, but for lasting quality, as a source of fertilization to be depended upon, I think the farmer must rely upon barnyard manure, as has been indicated this afternoon by my friend Mr. Cushman.

I would state, in this connection, an experiment which I made some years ago, which has established this opinion in my mind quite firmly. Six years ago I started an experiment with commercial fertilizers and barnyard manure against nothing. To one half-acre I applied one kind of the prepared commercial fertilizers, procured of one of the leading firms in a neighboring State; another half-acre I fertilized with a fertilizer obtained from one of our prominent dealers in Boston, putting the same value on each half-acre. To a a quarter of an acre, which was as much as I felt I could afford to try the experiment on, I applied nothing. To an-

other half-acre I applied good, solid, barnyard manure, at the rate of seven cords per acre. I planted corn, and the result was in favor of the manure. The fertilizers produced about equal crops. I will say here, that my crop was about seventy bushels to the acre, — a good crop. The second year I continued the same application. The third year, I laid the whole down to grass. The first crop of grass, where the barnyard manure was put, was a heavy crop; where there was no manure of any kind put upon the land, it was poor, of course. On the two half-acres where the commercial fertilizers were put, it was just about as poor as where there was nothing put on the quarter of an acre. It is now four years since I tried this experiment, and that half-acre where the barnyard manure was put still yields a good crop of grass and has done so continually during these four years; while the rest of the field, where there was nothing put, and where the two varieties of fertilizers were put, have been just about equally poor in their production. That experiment has been very valuable to me, and because of its value I wanted to bring it before you, showing, as it does, in my opinion, the difference in lasting qualities between commercial fertilizers, so called, and the old-fashioned barnyard manure.

Our friend who spoke upon the dairy interest to-day said a great deal about using absorbents in the barn to absorb the urine of the cow. That is a very important point. I believe our agricultural chemists (if we have any of them here I presume they will bear me out in the statement) consider that there is more value in the urine for fertilizing purposes than in the solid excrements of the animal. This is demonstrated to be so by analysis: whether it will hold out true in practice, of course, I cannot tell; but there is no question of the great value of the fertilizing elements in the urine of animals. How many cases are there all about us where farmers are allowing it to run to waste and deriving little or no benefit from it? In this new method of raising dairy products, where they save it so carefully in order to preserve the butter from being tainted, they gain another valuable advantage by that process; they save it by absorption. That ingredient is lost to many of our farmers; and in answering the question,

"How shall we fertilize our farms?" that is a very important feature, upon which great stress should be laid — not only the saving of all the solid manure, but of the liquid manure also. That point was brought out fairly and fully by the essayist, which I was very glad to hear. It is of very great importance. I am very happy to state that my attention has been called to the fact that a gentleman who is deeply interested in the agriculture of Middlesex County has offered a premium for the best essay upon the saving of liquid manure. This is a step in the right direction, and I would that the agricultural societies of the different counties would draw the attention of their members to this fact and consider the question whether it would not be well to add this to the list of their premiums. Allow me to read the offer, for it is very short:

"Having seen the good effect of saving the liquid manure, by building a barn cellar, some fifty years ago, nearly ten years in advance of other farmers in this county, and having carefully observed the great improvement in crops, I desire to see the manure from the barn cellar and farm carefully collected; and I offer, through the Middlesex North Society, a premium of ten dollars for the best written statement of the difference there would be financially between two farms in twenty years, other things being equal, the one to save all the manure of the barn cellar and the other to throw it out of doors, exposed to the weather, to freezing and thawing, to be washed by the rain and dried by the sun. The statement to be sent to the Secretary of the Society at Lowell, and the officers of the Society to select the awarding committee.

Very truly,

E. P. Spaulding."

It seems to me, as I have said, that this is a step in the right direction, to call attention to this great waste that has been going on upon most of our farms for this long series of years. Let every particle of these fertilizing elements be saved about our buildings and in our barns, and we shall not have to look about so much for the wherewithal to fertilize our farms.

Capt. Newell. I would like to ask Mr. Ware a question, if he will be kind enough to answer, as to the comparative

value of the manure he put on his plots and the commercial fertilizers.

Mr. WARE. I intended to have the commercial value the same in both cases. I said I applied the barnyard manure at the rate of seven cords to the acre, but I may be mistaken. I calculated the value of barnyard manure in the market, and intended to put on the same value of that as I did of the commercial fertilizers. I am very glad you called my attention to that, because, after I made that statement, I thought perhaps I might have made a mistake.

Mr. EMERY. Will the gentleman tell us what his manure cost on the land?

Mr. WARE. The gentleman will understand that I have just made a correction. I don't remember whether it was seven cords or not, but I put on the same commercial value, reckoning it at seven dollars a cord. That was about the value of barnyard manure in my locality at that time.

Mr. EMERY. The reason I asked the question is, that manure carried from the city and put upon the land will cost ten dollars a cord; that would be seventy dollars per acre.

Mr. WARE. I reckoned it at the market price in my locality.

Mr. EMERY. Twenty-three dollars' worth of commercial fertilizers to the acre would be enough to raise that amount of corn. I should say that the fertilizers would cost not over one-third as much as the barnyard manure.

Mr. WARE. I hope the audience will bear in mind that I have corrected my statement as to the seven cords per acre. I say that I put on the same value of commercial fertilizers that I did of the manure, reckoning the manure at seven dollars per cord.

Mr. EMERY. Would you think that twenty-three dollars' worth of barnyard manure on an acre of ground would carry it four years?

Mr. WARE. Whatever it was, it did do that, and there is the result now. You can see to a foot where the line was drawn.

Mr. EMERY. I use barnyard manure, I keep forty-five or fifty cows and thirteen horses, and make about a hundred cords of manure. I add to this about seventy-five cords of

the waste that comes from the cotton factories. There is undoubtedly some cotton-seed in that, but I use it as an absorbent. I put it in the gutter behind the cows, and by putting in two or three inches it retains all the urine. Then, in addition to that, I buy seventy-five cords of horse manure, and last year I bought ten tons of commercial fertilizers. I am as firm a believer in commercial fertilizers as I ever was, but as I have this manure, I save it and put it on my land. There is a stable adjoining me where they keep hogs; I buy their manure.

On sandy land, on a porous soil, I would not use barnyard manure, for corn or for rye; I would use commercial fertilizers. If you put on stable manure as you would put on the other, you will lose it; it dries up; the earth will not hold it. You put that on your low lands and you can keep it there. I seldom put on anything else but commercial fertilizers for corn or for rye on sandy land, and I always get very good crops. The fertilizer costs me about twenty-three dollars per acre for a crop of corn; perhaps, if I bought it mixed, it would cost more. I buy my muriate of potash and ground bone of H. J. Pecker of New York, the largest importer of commercial salts that there is in this country. I buy them in ten-ton lots. I also use nitrate of soda. I took the formula that I use out of Vielle's book, and I save from twenty-five to thirty per cent. — not over thirty, and not less than twenty-five — by mixing it myself. I intended to apply this mixture to my pasture last fall, but the weather was so dry that I did not put it on, because I knew I should get no result if I applied it. I use these commercial fertilizers on sandy soil. I also keep mixed a formula for grass. I go over my fields and wherever there is a place that looks as though it was a little naked, I have that fertilizer spread on that place, and in that way keep the field up even, unless there is some other cause below that the fertilizer does not affect. For top-dressing I should say that a commercial fertilizer was a good deal cheaper than manure. I can top-dress for seven dollars an acre, and with a good season obtain very good results. If you do not have a good season you cannot get anything from your manure, anyway; but if you have a good season, you will get a ton and a half to the

acre for that seven dollars, unless the roots are so thick as to crowd one another. If the roots become thick and crowd one another out, it is better to turn them over. It is folly to undertake to top-dress such grass land either with manure or with fertilizers. I have a very large amount of land under-drained. I have twenty-six thousand feet of under-draining, and where it is a vegetable bottom in one cultivation you cannot get down to the water-grass, — you cannot get the sour out of it. In about three years you will find the water-grass coming back, if you cultivate it but one year. It will require two or three times turning over before you get it so that it will hold timothy; the water-grass will crowd it out. I use about seven or eight hundred cords of night-soil in addition to the manure I have mentioned. I plough that under deep, and I do not calculate to grow an acre of grass unless it will produce two tons to the acre the first mowing. When it yields anything less than that I will turn it over. But if I had no other means of fertilizing, I should not go to the cities to buy manure and haul it home, costing me ten dollars a cord, to put on the land. I think it is much cheaper to buy the fertilizers to which I have referred. I think if the people in a town would club together and buy their fertilizer in ten-ton lots and mix it themselves, it would be much cheaper than to buy stable manure. You can buy "Vielle on Manure" and get a formula there for almost any crop, and you would save from twenty-five to thirty per cent.

I hardly think that if you put on but seven cords to the acre, it would be practicable to run ordinary land over four years. It might be on some ground that was more retentive; say, for instance, a close subsoil, made of marl or of clay. Marl will hold water as well as clay; and that marl or clay, coming up within twelve or nine inches of the top, will hold your grass two years longer than ordinary land where there is no close bottom to it. On under-drained black land, containing a good deal of vegetable matter, you will find that a dry season affects it very much. I cannot say why it is, unless it is that the character of the soil draws the sun and dries it up, but I find that I cannot raise a great many things on this black soil after it becomes very dry, especially

onions: and I cannot raise potatoes, either. But if you have black soil going down a foot and a half or two feet, and then coming into a close sand, it will retain the moisture, and you will get good crops.

Mr. Paul. Is your black soil muck?

Mr. Emery. I don't know but it might be called muck, in the common acceptation of the term; but I don't think many people understand what muck is: I don't know what it is myself. A black soil may be ninety-five per cent. sand, and it may be sixty-five; and if it is peat, it might come down to twenty-five per cent. vegetable matter. Now, a black soil, I suppose all of you know, is colored by the decayed vegetable matter. On upland, you do not find the black soil going down but a very few inches; on low land, you will find that it goes down deeper. On flat land, where there is a large quantity of wash, you will find it, where the humus or decayed vegetable matter is carried down by the rains. The soil will take that up as a sponge will take up water, and will hold it at the top. That is, it will hold all the plant-food at the top, if there is vegetable matter there to hold it; and after it gets full, the next year it goes below. It is like a cellar near a barn or near a vault, that gets impregnated from that barn or that vault and becomes unhealthy. It does not become so the first year. The filth is caught by the first soil to which it comes, and the next year it penetrates further, and it penetrates until it works its way through the wall into the cellar. But the soil holds the plant-food in the first instance, unless it is full and cannot hold any more. To show you the philosophy of that, the water used in this city was formerly obtained from a great many wells, and no better water was to be found anywhere than those wells furnished. When they came to analyze the water, after a good many years, it was found to be exceedingly impure: the vaults and cesspools in the city had carried a great amount of filth into those wells; but they lasted a great many years. If you sow your fertilizer upon these light soils, they will hold it on the top a sufficient time for you to get your corn crop. I don't think you will get on with it the next year. If you sow it on retentive land, on close land, what it does not take up this year, the crop

will get next year. In my first trial of a commercial fertilizer, I put it on a small strip one rainy day; in five days, you could plainly see where that fertilizer was put on. If it had been dry, you would not have seen it. The moment the rain takes it, the roots catch it and hold it.

Question. May I ask you if you put your commercial fertilizer on by hand or have some implement to do it with?

Mr. Emery. I had an implement that I put on the tail of the cart, but it was a good deal like many of these new things, it did not last long. I sow it by hand, and cross sow it, and generally mix sand with it.

Mr. Paul. Did you plough that stable manure under on that low, sward land where you used it?

Mr. Emery. Yes, sir; a portion of it I ploughed under, and then put on another large coating and harrowed it in.

Mr. Paul. Turned the sod right over?

Mr. Emery. Yes, sir. For grass land, I would like to have it near the top. The nitrogen works up, and I don't think the potash and phosphoric acid work down; I think they are held by the earth. If I was going to put on manure for grass, I should rather harrow it in, if it was well composted.

Capt. Newell. May I ask how much land you cultivate?

Mr. Emery. I cultivate about thirty acres in hoed crops. I can't tell you how many acres I have in grass. I cut one hundred and twenty-five tons of grass this year the first crop. I hope I shall get a hundred and fifty tons next year.

Mr. Mason. I want to ask if there is any gentleman in the audience who has ever brought up worn-out lands by the use of commercial fertilizers alone, so as to produce a good crop.

Mr. Emery. Mine was worn-out land. In 1873, a piece of land where I got fifty tons of hay this year did not pasture five cows. I don't think commercial fertilizers will last. I don't think it is policy to put them on only one year at a time.

Mr. Slade. Was not your land swamp land, that had not been cultivated before?

Mr. Emery. Where I got my best hay crop was swamp land. It is all under-drained now. I don't think there is

any of it but what gives me more than two tons to the acre.

Mr. Edson. I think we are getting to a point in this debate where it is very interesting. The discussion of this subject, will give us more information than all the essays we can get. My experience in putting on manures is that one load put on in the fall and ploughed under in the spring is better than two put on in the spring and ploughed under. I haul out all the manure I have in the fall and spread it upon the land.

My farm is in grass, nothing else. I allow it to lie on the ground just as long as I can in the spring before I plough it. About the last of May I generally break up the ground and plant with corn in order to get it back to grass. By the time that I am ready to plough, the manure has got half way through the sod, and the grass has started, so that in addition to the manure I have as much green crop as can be turned under with the manure. You have to put a chain upon your plough-beam in order to turn it under and make clean work of it. Then plant your corn, and your grass does not get a chance to come up before your corn comes up, and it is but little work to take care of it. After your corn is off, put in rye; then in the fall haul out your manure in the same way, let it soak in until the 20th of May, and the last of May you will have your rye up so that it begins to head, and you have got another green crop to turn in, and you have got your land in such condition that it will give you two or three tons of hay to the acre for six or seven years. I do not believe in top-dressing. When a field gives out, I want to put in the plough. By that mode of proceeding, in twenty-one years I have brought a farm up which was worn out when I took it. It kept a yoke of oxen, two cows and a horse, and I had to buy hay the first year I was there; and year before last I kept thirty head of cattle, four horses, and sold hay from that same farm. I have cut at the rate of four tons to the acre upon some of that ground. I have brought it up just in that way, keeping all the cattle I could. As the gentleman says, keep all the stock you possibly can. Perhaps I was a little fortunate in having a market where I could get more than two or three cents a quart for

my milk. I have bought about thirty acres of pasture land which did not come into the original farm. I have made it pay, and I say that a worn-out farm can be brought up, with judicious management. I think that the manure in great measure is lost, in many cases, by the mode of applying it. By putting the manure on the sod, letting it soak in with spring rains and turning under a green crop at the time the manure is partially through that sod and ready to receive the corn roots, your crop gets the full benefit of the manure. The dryest season I have had did not affect my corn. It will stand a drought under that mode of cultivation.

I think that we lose a great deal of the value of our manure by not saving the liquids. I have always been very careful about using absorbents to take up all the liquid manure. I perhaps have an advantage over many here in having so much sea-drift. I gather it and put it into the cellar for bedding.

Mr. Paul. Do you apprehend any loss from the exposure of your manure?

Mr. Edson. No, sir, I never saw any loss. I think it is the best mode of applying it. They say "the proof of the pudding is in eating it," and I have told you my experience. The object of my farming is to get hay. I can get a good price for hay, and there is always a market for it.

Question. Do you get four tons to the acre at one mowing?

Mr. Edson. No, sir. I had a small piece that I thought I would try and see what I could do with. I ploughed in all the manure I could. I sowed oats the first year and the second year. Then I sowed it down to grass seed in the spring and cut it green, and kept a horse one year with what I got from that field. I cut the oats early; it happened to be a good catch; and when I came to haul them into the barn, I did not weigh them, but I hauled seven single horse-cart loads the first cutting, and the second cutting I hauled three. I can haul enough to make half a ton. It is a pretty big story, but that is the fact in the case. It was a clay soil, tenacious, and would hold all the manure I would put on to it. That was six years ago, and the field feels the effect of

that manure to this day. I can keep up my land in that way, and I do not know of any other way to keep it up.

Mr. E. P. Spaulding. I rise here as the oldest member, probably, of the Middlesex North. I want to congratulate the State Board upon the success of the meeting we have had here. I believe they have enjoyed it. Probably they will go home and tell their children, and let their children tell the next generation, what has been done here in Lowell. I will say to the members of the Middlesex North, — my children, I call them, in some measure, — I hope they have done as the old man told his boy when he went to a raising. They had a good supper after the raising, and he says, "John, take large mouthfuls; we don't have any such victuals at home." I hope my children of the Middlesex North have taken large mouthfuls mentally. I want to know if there are not brains enough in the State, if there are not in the Middlesex North, to write that little essay that I have offered a premium for. I offered it last year, but it was not put in the regular list of premiums.

Mr. Stewart of Dracut. Facts without figures lose half their value. I wish to take exception to one remark of the essayist this afternoon in regard to the value of muck, although it was rather an inference than a statement. As I understood him, the inference would be, from what he said, that muck is of no value. I think it is of great value as an absorbent, and that is its greatest value, — muck from your peat meadows, and muck from anywhere else, as long as there is humus about it. We know that a carcass buried one foot deep in dry muck will give off no smell; it therefore holds all the ammonia, which is the most expensive ingredient of these commercial fertilizers.

The Chairman. There is no question of the value of muck as an absorbent, when convenient to the barnyard, and the value of muck as a fertilizer has been settled by the Board. I beg that that may not be made a matter of discussion at this time.

Mr. Stewart. The main point I wished to make was this: Commercial fertilizers have their place, after every load of manure from your barn cellars has been used. That

they are of use I know from experiment. In planting corn fodder, I used twenty cents' worth of Stockbridge fodder-crop fertilizer per row, and left one row in the middle of the field without any of the fertilizer. I got one hundred and twelve pounds, without the manure; I got three hundred and twenty-four pounds with the manure, — the second row from the one that had none. If we can get two hundred and twelve pounds of corn fodder for twenty cents, I think that it pays us, especially if every atom of our manure has been expended and we could not have got that if we had not used it.

Mr. King. I shall detain you but a few moments, but having had considerable experience in the use of fertilizers, and coming from Essex County, the neighborhood of my friend, Mr. Ware, who spoke to you, I rise to corroborate many of his remarks. A few years ago I was conservative; I did not believe in commercial fertilizers; I thought that it would be a waste of money to buy them. But when Prof. Stockbridge came out with his, and they were spoken of in such high terms, knowing him as I did, I ventured to try my first experiment upon an acre of corn. The year previous the land was planted with cabbages, and, being some distance from my house, it was rather difficult to haul the manure, and I only put four loads on that acre of land. The next year I planted in rows, both ways, thirty-three hundred hills of yellow corn, and I raised from that acre ninety bushels of shelled corn. It was the heaviest crop of corn that has been raised in my neighborhood in my remembrance. I allowed eighty pounds from the ear to make a bushel.

This year I took one barrel of the Stockbridge fertilizer and used it for nine hundred cabbage plants. I took the same number of hills on the other side of the piece and applied stable manure at the rate of seven cords to the acre, and after those cabbages had grown, a man must have been blind, if he could not see the difference in favor of the fertilizer, and it proved so up to the end. I claim that we cannot keep up with the age in farming unless we use, to a certain extent, these commercial fertilizers.

I do not believe in top-dressing grass land; if we put

down our lands in good condition, they will produce a good hay crop for four years; then, when they are run out, turn them over in the month of September and sow nothing but grass, and you have a right to expect a good crop of grass for four years. That has been my experience, and the experience of a good many successful farmers in my neighborhood.

I want to say this in regard to the valuation of our farms. What drives the young men from their homes is this heavy taxation, but if farmers have not the courage to stand up for their rights, it is their own fault. The farmers of Massachusetts ought to make the welkin ring with their demands for reduced taxation upon their farms. In a pecuniary point of view, so far as I am concerned, it would be no benefit to me or mine; but when we say that farming does not pay, we ought to remember that there are reasons why it does not pay.

Mr. Edson. In turning over exhausted sod in that way, and sowing it down to grass, do you get clear of the wild grasses and weeds.

Mr. King. Yes, sir; I have never had any trouble about it.

Mr. Edson. I have used commercial fertilizers with my barnyard manure. I get a quantity of some fertilizer and tell my man to sow it upon my grass land and not let me know where; if I cannot find out by the grass, I don't want any more; but if I can find out, I purchase more. I have tried it every year, and I do not know of but two years that I ever got my money back. There were two years that I think I got my pay in the first year's crop for the commercial fertilizers that I applied. It seems to me that applying commercial fertilizers is like giving a man a glass of whiskey to get a good day's work out of him. The next year I think the land is poorer than it was when you put it on. I don't think it has any lasting effect. It will force a crop. You can get a good crop of turnips, for instance, without any other fertilizer, but you do not improve your farm; your soil is no better after you get that crop off than it was before. That is my experience. But when you give your land a good quantity of manure and plough under a good

green crop, then you get land that will run for five or six years; but if I should turn over my soil, as the last speaker has described, and sow grass seed on top, without any cultivation, I should not get rid of the pest of wild grasses and weeds.

Mr. Mason. I have failed to get an answer from our friend from Lowell. As I understand, he produces from one to three tons of hay without manure of any kind. If he has such land as that, he of course has not brought it up by commercial fertilizers. I have been through Massachusetts, New Hampshire and Maine somewhat, and I have failed to find a farm brought up from a low state to a high degree of fertility by commercial fertilizers alone.

Mr. Emery. I will answer that I have done it, for one, and it does not cost so much as manure. The cost of the commercial fertilizers will be about as one to three compared with manure. That is, if the manure ran out in three years, you could keep it along with these fertilizers.

Mr. Munson. The essayist spoke of seeding muck lands and taking off the coarse grass. I wish to ask him what kind of grass he would sow after the coarse grass is taken off? Also, what he would consider the fair market value of the hard-wood ashes that he spoke of, to be used in agriculture, in raising farm crops — corn or potatoes?

Mr. Cushman. In the case to which I have referred, I had to chop the peat with a broad axe, and cut it up with a large hoe that I have made for the purpose, turn it with a fork, and then cart on, when it was frozen, a light coating of sand. After that, I put on fine, ground bone, usually in the spring, or early in the fall, if I can get to it. But this work is done in the winter, as I remarked, and I sow red-top and herds-grass, but no clover.

I take a different view of this matter from my friend Mr. Emery. My experience in the use of nitrogeneous manures, especially stable manure, on land of that character, has not been satisfactory, from the very reason that it has caused my grass to lodge. It would fall down long before it would mature any such crops as that gentleman speaks of — two and a half or three tons to the acre; whereas, when I manure with fine, ground bone, the stalks have more strength

and will stand up, and I am enabled to get a more valuable crop.

I have regretted the turn that this discussion has taken. This Board has been laboring now for twenty years, almost, upon this question of fertilizers, and it is about time that we acknowledged that something has been done, that we have learned something. We have spent our money and paid our high taxes, to which some of the speakers have referred — and have we not got anything in return? Has not the State Board of Massachusetts beaten anything into us as farmers? Don't we know anything from what they have taught us? If we do, let us sum it up and see what we know. Have they not taught us one thing — that plant-food is manure? Gentlemen talk as if there was some magic about commercial fertilizers. Do we not all know that any manure depends for its effect upon the plant-food that it contains, the phosphoric acid, the nitrogen and the potash, and it makes no difference whether it is barrelled up and labelled one thing or another? Have we not learned that? If we know it, let us take it as an accepted fact. We can just as well build up an exhausted field with manure that is called by one name as another. If it only contains the potash, the phosphoric acid, and the nitrogen, what do we care what its name is, or in what form it comes to us? It makes no difference.

The only question is, where can we buy these three elements the cheapest? What name do they come under the cheapest? That is the question. With what are they compounded? They are compounded sometimes with substances with which they are not so available as they are when combined with other substances. When we buy our potash and phosphoric acid in stable manure, it is not so available as it is when the venders of commercial fertilizers have manipulated it and made it available almost instantaneously, so that when our farmers sow it on a rainy day they see its effect the next day in the deeper green of the grass. Then what must we do when we apply these elements in the form of stable manure? We must convey them to the plant that is greedy, that can digest them, that can assimilate them. There is no plant that we grow that is so greedy and will eat

so much stable manure as Indian corn. If I apply potash, phosphoric acid and nitrogen in the form of stable manure, I will put it under Indian corn. If I have those elements in another form, and I wish to have them act instantly, I will put that fertilizer immediately under the little rootlets of some plant that I want to force ahead quickly. But let us remember all the time, that it does not make any difference whether we carry these elements of plant-food in carts, or casks, or sacks. It makes no difference what we name them; the only thing to be considered is, whether we have the phosphoric acid, the potash, and the nitrogen there, and if they are there, let us use them, and know that we can build up any land and raise almost anything that we wish to raise.

Now about ashes. I sometimes go to a family that I know burns good hard wood, oak or hickory: I say, "I want your ashes." "What are you willing to pay for them?" "I will pay just what you ask; I will pay you double what the soap man will pay you, if you will save them and be sure not to put in any coal ashes or soft-wood ashes." If they do not ask over seventy-five cents or a dollar a barrel, I take them.

Mr. Paul. I do not wish to enter into any controversy, but I hardly think that Mr. Cushman meant to say that it did not make any difference in what form phosphoric acid, potash and nitrogen were applied, because they are readily available in some forms and not in others. Acted upon by sulphuric acid, of course bone is available immediately, but if not broken down, it is not readily available as plant food.

I think we may make mistakes in regard to what we call exhausted land. I have in mind now a field which has been a matter of a good deal of interest to me. The owners of it were engaged in catching menhaden, and whenever they returned from their fishing expeditions, they sold what they could, and perhaps they would have ten or twenty barrels left, more or less, and it was applied to this field of four acres. They applied the fish there year after year, and the crops were enormous. Finally, the field became exhausted, apparently; it produced nothing; it did not even grass over; weeds did not grow upon it to any extent. It had been lying in this condition some few years, and the owner

thought he would plough it and plant it with corn. He purchased some ashes and applied a handful to each hill. The land produced a moderate crop. The next year he sowed oats, and where the hills of corn were the year before, the oats grew finely, showing that the soil had not been exhausted, but that there was simply an exhaustion of the potash. In applying the fish, he had applied nitrogen and phosphoric acid, but the potash had been exhausted, so that the field would not produce crops. Acting upon the suggestion which he got from the effect of the handful of ashes upon the corn, he applied ashes to the field, and, behold! it was a fertile field. Potash was the only thing that was required.

I would say a word further in regard to the use of fertilizers. I am very much amused as I hear these discussions from time to time, and it does seem, as Mr. Cushman has said, that we ought to settle down upon something, so that we shall not have to take up every year the same old questions. I used Peruvian guano twenty-seven or twenty-eight years ago, and continued to use it. I have used many of the fertilizers in the market, and have used them more or less a good many years. I have used perhaps as much as fifteen tons in a year. Well, most of them have paid me. I have not been exact in my system of farming; I have not kept accurate accounts; I have not kept an account of debit and credit with each separate field; I have only, at the close of the year, examined my pocket-book; and if I find that I have something left after paying my debts, I say, "This year's operations have paid me." I have purchased fertilizers that did not pay me. I do not say they were not good, but they have not acted on my crops; they have not given satisfactory results, in a few instances.

In regard to the purchase of manure, if I could purchase stable manure as Mr. Rawson can, I should purchase it more largely than I have heretofore. He says it costs him six dollars and a half a cord delivered upon his land. I should think that that would be a cheaper source of plant-food than any that I know of. I have used the dissolved bone; I have used ground bone, as we call it; I have used powdered bone; and, mainly, they have paid me. I do not feel afraid to apply these fertilizers in view of any injury they may do my

soil afterwards. My land holds its own, continues to improve, and bore better crops, with the dry weather and heat of the past year, than the year before.

Mr. CUSHMAN. The gentleman did not quite get my meaning in the remark I made. I said that if you got the quantity of nitrogen and these other substances, it made no difference in what form they came, or by what name they were called. In regard to ashes, some gentlemen might consider that I overestimate them. I consider them worth more than perhaps twice the value of the potash which they contain for the purpose to which I apply them, to dissolve bone. I always mix hard-wood ashes with ground bone, the finest ground bone I can find in the market, which I consider cheaper than any of the coarser grades; I want something to break it down, to make it available. I take hard-wood ashes and this ground bone, and mix them, for some crops, in equal parts, and wet them, and in about fifteen or twenty days I find the bone dissolved. The hard-wood ashes are just what I want for that purpose, and I can afford to pay the price that I am paying and use them in that way.

QUESTION. Do you use any leached ashes?

Mr. CUSHMAN. I have not, lately, from the very fact that I felt that I had been imposed upon. In buying leached ashes, I could not avoid a great many coal ashes and ashes of inferior quality, and if I cannot get hard-wood ashes, I take muriate of potash.

EVENING SESSION.

The meeting re-assembled at seven and a half o'clock, Hon. JAMES S. GRINNELL in the Chair.

The CHAIRMAN. Most of you know that it is the custom of the Board of Agriculture, at their country meeting, to arrange that the entertainment of the evening shall be something not entirely of an agricultural character, but something more popular, that shall interest and instruct a general audience. The committee have invited for that purpose, to-night, one whose name extends far beyond the limits of the United States, and whose teachings are more generally

received than those of almost any other man who writes for the benefit of the farmer. It is with the greatest pleasure that I present to you one who needs no introduction, one of your own neighbors, Dr. J. R. Nichols of Haverhill. (Applause.)

Dr. Nichols lectured on "Sunshine on the Farm."

THIRD DAY.

The Board met at nine and a half o'clock, Mr. O. B. Hadwen of Worcester in the Chair.

The Chairman. Gentlemen of the Board of Agriculture. — This is the third and last day of the sessions of the country meeting of the Board. We can congratulate ourselves that we have had a very interesting meeting; that good subjects have been discussed, profitable to the farming interests of the State. We are now coming upon another subject which is one of great interest to certain sections, and one that I think will interest us all as farmers; that is, the culture of the cranberry, and the destruction of the insects that are likely to injure it. I am happy to introduce to you this morning Mr. Stearns, of Amherst, a graduate of the Amherst Agricultural College, and one who takes a great interest in the college, having made large contributions to its cabinet of birds, shells, insects, etc.

CRANBERRY CULTURE AND ITS INSECT PESTS.

BY WINFRID A. STEARNS.

The greatest enemies of the cranberry grower in the Eastern United States are two small caterpillars, known, wherever they occur, as the "vine worm" and the "berry worm." The ravages of these small insects in this State alone, during the past year, probably amounted to from $10,000 to $20,000 at the very least. These two worms work separately and at somewhat different times in the year, yet so effectively, that, at the end of the season, but little remains of the expected large crop. The so-called "fire blight"

is the result of the ravages of the "vine worm," while the berries as they grow are attacked in an early stage of their development and destroyed by the "berry worm." These latter eat into the heart of the berry, which, in consequence, turns prematurely red, dries up, and finally falls to the ground.

Before proceeding further I would here thank the gentlemen whose correspondence I have solicited while engaged in this study, and who have added in many instances, very important and satisfactory evidence upon obscure points and "mooted" questions, and especially Dr. C. Briggs of North Rochester, Mass., without whose valuable assistance very little would have been accomplished.

I will state, also, that I undertook this work chiefly at the suggestion of Dr. Goessmann, Director of the State Experimental Station.

In studying these enemies of the cranberry it will be necessary, first, to revert to the former published accounts of their appearance and ravages in this and neighboring States, that we may refresh our memory with the substance of what is already known of them, to which we will add such facts as have come under our observation.

This present paper will contain little save a resumé of what is already known of these insects, and a series of letters concerning them from and to various cranberry growers in the State.

The following are *abstracts* from the various reports from which they are taken.

Abstract of First Annual Report Massachusetts Agriculture, 1853, in quite an article on the cranberry, on p. 58, part I., "The Cranberry Worm," it says: —

"Eggs supposed to be deposited in the blossom; the caterpillar works its way through the fruit, eating the pulp and causing the green fruit to turn red prematurely and decay. It bears a striking resemblance to apple worm; is a small, naked caterpillar, with habits like those of the apple worm. Each berry is tenanted by a single worm.

"I am not acquainted with any other insect attacking the cranberry. Remedies suggested: Flow the cranberry ground one whole

year, losing one season's crop; sow salt upon bed, five or six bushels to the acre. Cranberries growing on or near a salt marsh are best and biggest. Salt, therefore, would not injure the crop if it did not prevent the ravages of the insects."

Abstract of same Report, p. 247, part II. : —

"Every year since 1840 these vines were regularly eaten by a cranberry worm. This worm may be the same, or a species of worm which operated last June on the apple-trees. Some years the vines present to the eye the same appearance as an orchard eaten by the canker-worm. The worms were destroyed by keeping them under water from spring till July 1, 1852. This did not injure the vines.'

Abstract of Third Annual Report Massachusetts Agriculture, 1853, p. 123, part II., under heading "The Vine Worm": —

"So great and fearful are its ravages that vines attacked will, in a night, seem sickly and the crop be cut off. It does not attack the growth of the year previous to its coming, but begins from the base of the new growth of the year in which it begins its attacks. It works upward; seems to settle itself under the young leaves. After feasting on the vine it webs itself up and leaves upon the vine the appearance of 'fire blight.' It appears soon after blossoming; often attacks certain sections of the cranberry yard, leaving others untouched. It is described as an eighth of an inch in length."

Abstract of Eleventh Annual Report Massachusetts Agriculture, 1863, p. 101, part I., "Insects": —

"There are two worms, known as the vine worm and the berry worm, injurious to the cranberry. The first is a caterpillar, about half an inch long, with the second probably a circulio. The vine worm destroys the leaves and blossoms, consequently the crops. The bogs appear as if they were burnt over. Cyrus Cahoon, Esq., says that if the vines be kept under water till the 25th of May or 1st of June, these pests rarely commit any depredations; but one-half the bogs in this country cannot be kept flooded till June 1. Dr. Shove of Yarmouth, and Rev. Mr. Myrick, have experimented with decoctions of tobacco, and been partially successful. Prof. Agassiz suggested building fires at the season when the miller appeared, by night; it would then fly into them, before laying their eggs, and be destroyed. Dr. Shove says that the

miller appears about the time the berry begins to form; it punctures the berry and lays its eggs under the skin. Flowing in June does not always accomplish the required result, as many of the worms turn to the pupa state outside the patch and are consequently not affected by the water. The vines are retarded by the flowage. It has not been ascertained that the chrysalids are killed by the water."

Quotation of Twelfth Report Massachusetts Agriculture, 1864, p. 157, part I. In an article by F. G. Sanborn of Boston, on "Insects and their Relation to Man," he says:—

"A moth, nearly related to the destroyers of our furs and carpets, deposits her eggs in the calyx or blossom end of the young apple, about the end of June. The eggs in a few days give birth to small, white caterpillars, with blackish heads, which burrow into the core, and open a hole on the side through which they eject their castings. This injury causes the fruit in about three weeks to become prematurely ripe and fall to the ground; soon after which the grubs leave it and make their cocoons in crevices of the bark. It has since proved very destructive also to the cranberry. The moth is described by Mr. Tufts as having the upper wings of a light slate color, crossed by wavy bands of a darker shade; towards the tips of each an oval spot of a burnished copper lustre will be seen; the feet, antennæ, and body beneath are of a light gray; it expands about three-quarters of an inch."

Abstract and quotation of Fourteenth Annual Report Massachusetts Agriculture, 1866–67, p. 283, part I. In Geo. A. King's "Culture of the Cranberry," he mentions two worms injurious to the cranberry — a "vine worm" and a "berry worm": —

"1. Vine Worm — First presence, the latter part of April, of a small miller. It 'punctures the fruit-bud and lays its eggs within it;' and disappears after about ten days. The larva 'makes its appearance in the bud about the fifteenth day of May;' it feeds upon 'the vine and buds,' grows rapidly, and 'comes to maturity in about ten days.' It then 'webs itself up and lies in the chrysalid state for seven days.' The miller then shows itself for ten days, lays its eggs, and disappears as before' This [second] generation inflicts no material injury upon the vine, and are in comparatively small numbers. Two weeks after the miller disap-

pears, — the last of June or first of July, — the larva of next generation appears upon the vine and ravages for ten days. It begins at the top and eats downward. It is said that three, and perhaps four, generations appear in a season, it being found as late as October. The *vines* do not suffer from them materially except during the early parts of July. They eat the previous year's growth only when in large numbers, confining themselves principally to the new growths of 'the year in which they make their appearance,' as has been stated by another previous authority. The vine is protected by flowing. If the water is kept on until first of June this generation of the worm is prevented. 'Resembles the apple worm:' 'Its color is light, with a bluish tinge, and its head is black. It is about three-eighths of an inch in length when fully grown. The miller appears to be somewhat longer, is of a gray color, and has a white stripe across the back.' He says: 'It flies but a short distance, usually not more than a foot at a time.'

"II. Fruit worm. Berry worm. — 'The miller is first seen about the twenty-fifth of May.' About the 'middle of July it deposits its eggs under the skin of the growing fruit.' The worm 'makes its appearance in the berry during the last of August.' Its 'presence is shown by the premature redness of the fruit.' 'In ten days he destroys the berry and passes into another.' In the 'early part of September it passes into the ground until the following twenty-fifth of May.' It does not do nearly as much damage as the vine worm does. The remedy is to 'flow the bogs after he has eaten out the first berry.' It 'resembles the vine worm in size and form.' Its color is 'white, with a yellowish tinge, and its head is red.'"

In the Seventeenth Annual Report of Massachusetts Agriculture, 1869–70, p. 239, Part I., Prof. A. S. Packard's "New and Little-known Injurious Insects," the number of cranberry worms is increased to three, all of the family Tortrix.

I. The glistening Cranberry moth. Tortrix oxycoccana, *Pack.* (*?*)

II. The Red-banded Cranberry Tortrix. Tortrix incertana, *Clem.* (*?*)

III. The Yellow Cranberry worm. Tortrix vaccinicoorana, *Pack.* (*?*)

But he adds that the latter was sent from New Jersey, and

had not been found in New England. The other two, though quite fully described, are accompanied by no explanatory notes, and as there is nothing with which to make the comparison we cannot tell if either of them correspond to the fruit worm of the twelfth report, or the berry worm of the eleventh report.

Now the Report of the United States Department of Agriculture for 1869, tells us that this same third species of Packard, reports from Cape Cod, Mass.; but neither does this correspond to any worm that has been hitherto described that we can tell. Prof. Packard in his "Guide" tells us that the larva of this third species is known as the "fire worm," destroying the vines and tender shoots as if they had been burnt over with fire. Now the larvæ of this worm are so much larger that they cannot be the same mentioned in the third report, by the name of "vine worm" and "fire blight," unless, perhaps, the latter were taken when very small, being mentioned there as "$\frac{1}{8}$-inch" long only.

Are there, then, five or six species of these Tortrix moths that feed upon the vines and berries of the cranberry? We believe that there are, or at least *may be*. An example of this kind occurred in the family Agrotis, or cutworm, as a simple passage from Harris's Report of the Insects of Massachusetts, 1841, p. 322, will show: —

"Several years ago I procured a number of cutworms in the months of June and July. Though varying in length from one inch and a quarter to two inches, they were fully grown, and buried themselves immediately in the earth with which they were supplied. They were all thick, greasy-looking caterpillars, of a dark ashen gray color; but I neglected at first to examine them carefully in order to see if they were marked exactly alike. Much to my surprise, however, these cutworms produced five different species of moths."

This is, to be sure, a single example; but it is sufficient to show us how useless it is to make comparisons that can be relied upon with any degree of accuracy, without following out the entire history of *each individual* that presents the *slightest noticeable difference in size, shape, markings or ornamentation*, and noting with exactness each stage to the

complete insect, which may even then differ in color and markings in the different sexes.

On the other hand, while it is true that we may have five or six species of Tortrix moths, feeding in their larval stage on the cranberry, it is also certain that, as yet, but two are the occasion of any very serious trouble, as far as is generally known, on the plantations in this and neighboring States.

We have seen in the twelfth report that the moths there mentioned are described as from "small, white caterpillars, with blackish heads," and that, throughout the reports generally, this characteristic seems to be referable to a single species, and this is probably also the same as that mentioned in the fourteenth report, though it says, "Its color is light, with a bluish tinge;" it also says, "its head is black, and it is about three-eighths of an inch in length when fully grown." This, then, is still another point of dispute. Are there two distinct species of vine worm? or are the descriptions referable to the different stages of one individual?

In June, 1883, I wrote to Dr. C. Briggs of North Rochester, Mass., who very kindly sent me specimens of the vines as infested with "the 'fire worm,' so called." He adds that, "the worm, when very small, apparently just hatched, appears first in the cranberry buds, and it is thought by many, that the miller always deposits in the bud, or where the bud will appear."

The vines sent me by Dr. Briggs were infested by a worm which is apparently the same as the species noted above in reports twelve and fourteen, and seem to be all the same species. They all act in apparently the same way, and though some are plainly and evidently "white caterpillars, with blackish heads," others are also "light, with a bluish tinge," and "its head is black," still others are "pale, honey yellow," with a slight greenish tinge, a little stretch of the imagination reconciling the deep olivaceous color of so many caterpillars (so natural to them, I mean) to either of the above tints. Now, in the cases above-mentioned, the head is black, whether the body be honey yellow, white, or tinged with green or blue. In a single specimen obtained later, the body was small and greenish, with the head not black but with a distinct tinge of dark, almost black amber

color; while in another specimen which had just suspended itself into a pupa, the head was decidedly dark, honey yellow or amber yellow. Still entertaining the possibility, as before stated, that there *may be*, four, five, or even six species, and it is not at all unlikely for this to be the case, we have plainly the other argument, that of a number of persons describing the different stages of the same insect, which brings us at once to the conclusion that the several descriptions in our reports and our entomological authorities may resolve themselves into one, two, or at most the three species mentioned by Prof. Packard in his "Injurious Insects, New and Little-known." Until the moths appear, I cannot tell further what may be the results of the development of those species which have been sent to me by Dr. Briggs.

From the observations I have made already upon this caterpillar, I feel confident and tolerably certain that all the caterpillars mentioned in reports one, three, eleven, twelve and fourteen are *simply different stages of the same species*. Is it, then, one of the three species mentioned by Prof. Packard in the seventeenth report? If so, which one? Let us endeavor to ascertain as far as our facts will permit.

The following correspondence aids us and speaks for itself. It presents so many valuable hints and suggestions, and contains so much really useful information that I present it entire. I obtained most of these letters through Dr. Briggs, and am therefore especially indebted to him for them.

The first is a letter from Mr. L. H. Small, dated —

HARWICH, Sept. 14, 1868.

DR. C. BRIGGS, *Dear Sir*: —Your very welcome favor of the 11th is at hand. You speak of the very discouraging prospects for a crop in and about your vicinity. Our crop on the Cape is very light, and in Harwich almost an entire failure. Having been troubled with the *fire worm* we kept the water on later than usual, but the season being very backward we have failed to kill the borers. We kept the water over the vines in many places where no worms had been so late that the blossoms did not set with fruit in time to mature.

In regard to the vine worm I would say, that we usually have three crops of them when the vines are not flooded. The first worms make their appearance about the middle of May; the second, about the 10th of June; the third, the last of August or first of September; but they

may vary quite widely from these dates, according to the season, location, and the surroundings. Their first and last visit is comparatively harmless, but their July call is the destructive one. When full grown, the vine worm is about three-quarters of an inch long, a little less in size than the telegraph wire, — the body a light smoky color, with a blackish head, and almost exactly of the size and appearance of the worm that eats the berry. Many think them the same, but I am very certain they are not. The worm that eats off the stock is not usually very troublesome. I have never known them to eat after the first and second year, — they seem only to operate while the vines are young and the ground is soft.

The second from the same gentleman. He says : —

Harwich, Jan. 19, 1882.

Friend Babbitt : — Yours at hand and contents noted. I think you have been very fortunate in being without the *fire worm* so long. I have had them to contend with on some of my bogs about every year since I have been in the business. When I have water, so that I can flood at any time, I have no trouble in destroying the worm. The fire or vine worm, and the berry or fruit worm, are entirely different worms, notwithstanding they look much alike. The fire worm is from the egg of a little gray miller, and is deposited on the under side of the leaf, and the first crop of them, where the vines are out of the water, commence hatching and eating soon after the vine starts, say from the 10th to the last of May, according to the situation of the bog and forwardness of the spring ; this crop is not often very injurious or destructive. They work about two weeks, then go down into the ground or dead foliage, and come up again in the miller state, and leave their eggs for the next and most destructive crop, which begin their work about flowering time, which with us is about the 10th of July ; so much for the habits, etc., of the insect. Now to kill them. When you have plenty of water, and can flow in a few hours, I should let the water off the 15th or 25th of May, and put it on again for a night or so at a time up to the 10th of June. You can't flood again after letting the water off. I think it is best to keep the water on pretty late, say to the 5th or 10th of June, until the water gets warm enough to destroy the eggs. In some situations, when the water remains cold from springs, this method fails to produce the cure, and if the water is kept on too long or too late the vines will not flower. In two instances I have kept the water on until the middle or last of August, — of course no crop that year, but the best I ever had the next, and good several years after. The water on so long during the hot summer seemed to destroy all the enemies of the berry and vine.

The winter flowing is desirable to protect the vines against the severe winter frosts; don't think it has any effect on the insect tribe or their eggs. Warm water hatches them out, and water drowns them, young and old.

Yours truly,

L. H. Small.

A short paragraph from another letter may be of interest: —

Harwich, Aug. 4, 1882.

Friend Babbitt: — Yours of the 2d at hand. In the bog that was under water last summer about all the month of August, I did not succeed in killing the worms entirely. The reason, I think, was that it was flowed too late. I proposed to the agent to flow it about the 10th of July, when the destructive swarm first began to work, but he did not do it until about the first of August when the insects were in the miller state, who used their wings and left their eggs on the border of the bog. I tried it on a small bog, when the miller was out, with the same result, but another bog which I flowed on the 5th of July, when the worms first came, and kept under water about forty days, was a perfect success and seemed to destroy not only the vine worm but the fruit worm and all other insects, and I had the best and largest crop the bog ever produced.

Yours truly,

L. H. Small.

In "Cranberry Culture," Joseph J. White, March, 1870, in speaking of the "fruit worm," says:

"This larva bears a striking resemblance to the ordinary apple worm, and, like that, is lazy and sluggish in its habits. We have reason to believe that the perfect insect lays its eggs under the tender skin of the newly formed berry. The egg is hatched by heat and the young grub eats its way into the heart of the fruit, causing certain destruction. It has been asserted by some cultivators that one worm will destroy one berry only; but this is a mistake; the same worm will frequently destroy at least two. This is fully established by the fact that two berries may be found with a hole passing directly from one to the other at the point where they come in contact, — one being red and the other fresh and green with a nearly full-grown worm in it; as further evidence we may state that worms have been discovered on the passage from one berry to another.

"This premature coloring of the berry — the effect of the fruit worm — has been observed in New Jersey as early as the 10th of

July, on the dryest meadows, and later on those that are moist. Its ravages continue until the 1st of September, after which the remains of the fruit are visible in the form of dry, hollow shells, from which the worms have disappeared. These shells may be counted upon a given space, and the damage ascertained by proportioning them to the amount remaining sound. In dry seasons the loss resulting from the fruit worms frequently amounts to one-half of the berries formed; and, in some cases, it has been so great as to leave only one-tenth of the fruit to come to perfection.

"The effect of moisture at this time seems to be to keep the bottom cool, and thereby to prevent the hatching of the worm."

Mr. Fish observes: —

"When fully grown, the worms enter the ground and spin their cocoons within a few inches of the surface. The cocoons are covered with grains of sand, and are hardly distinguishable from small lumps of earth. They remain in the ground all winter. In the spring of 1867 I bred two species of ichneumons from these cocoons that had remained in the house all winter."

Of the "vine worm;" he says very little, but quotes from James A. Fenwick as follows: —

"The vine worm feeds on the under side of the leaf leaving nothing but the veins, and increases rapidly to a countless multitude, causing the meadow infected by them to appear as if scorched by fire; hence their name, 'fire worm.' Upon observing a meadow infested by them in April I found the worms feeding upon the leaves, and partially surrounded with webs. In June I noticed they had webs enclosing clusters of vines (ignorant persons thinking them spiders' webs) apparently sheltered from the weather. Upon approaching them with a heavy tread, the worms suddenly disappeared, dropping to the ground; but, stepping noislessly, and touching the webs, the worms would drop into my hand, making, at the same time, vigorous efforts to escape. By the close of July not a worm could be seen, but the webs remained; doubtless the worms had enclosed themselves in cocoons. In August, the millers rose in numbers around my feet, taking short flights, and again settling upon the ground; by September these had disappeared and the worms increased an hundred fold; evidently showing that two generations of these insects were hatched in one season."

In this same book the author says: —

"In New Jersey the larvæ are quite common in the month of September, and may frequently be found in October. We are disposed to believe that many of them live through the winter in sheltered places, securely wrapped in their webs. This fact is confirmed by the fact that large-sized larvæ may be found early in the spring; and also from our having kept a worm in a cold room until March with every indication of its living until May."

He states also that —

"The worm made its home among the feather-leaf (*Cassandra colyculata*) and low-bush huckleberry, until the days of cranberry culture."

The essence of his remarks seems to be that the water, in May, should be put on until near June 1, and that the vines should be covered with water until just before they blossom.

My correspondence with Dr. Briggs, himself, has been especially interesting, and I make a separate clause of his communications upon the subject. His first letter, in June, 1883, contains advice of specimens sent me for examination, and reads as follows: —

North Rochester, Mass., June 4, 1883.

W. A. Stearns, Esq.

Dear Sir, — I send you by mail, this morning, some cranberry vines infested by the "fire worm" so called. The worm, when very small, apparently just hatched, appears first in the cranberry bud. And it is thought by many that the miller always deposits the egg in the bud, or where the bud will appear. The worms have now appeared on the edges of my cranberry vines not now covered with water. The morning is rainy, otherwise I would send you more of the worms — will send more if necessary. In haste for the mail.

Yours &c.,

C. Briggs.

North Rochester, June 20, 1883.

W. A. Stearns, Esq.

Dear Sir, — Yours rec'd. Last Monday, I sent you a small box by mail containing several specimens of the "fire worm" with the branches of vine on which they were found. In the bottom of the box are four chrysalids which were found in webs on the vines. From their form and appearance I think they are chrysalids of the "fire worm."

Last year I let the water off my vines about the first of June, and the "fire" appeared about the eighteenth or twentieth of the month, but did not do much damage. About the twentieth of July the worms appeared in full force and destroyed my crop of berries. I have seen but one species of the worm, but it varies in appearance somewhat at different stages of growth. They are first found in the opening bud, and it is thought by many that the eggs are always deposited at the points where the buds are to appear, and that when the buds begin to grow the eggs are enclosed in them and there remain until hatched.

Probably the best time for investigation will be when the second brood shall come, sometime in July.

Yours truly,

C. Briggs.

North Rochester, July 23, 1883.

W. A. Stearns, Esq.

Dear Sir, — On the fourteenth inst. I sent you by express a box containing vine worms, with some of the moths. I trust it reached you safely. Last Saturday my vines were examined and seemed to be entirely free from the vine worms. It is time for the second crop to appear, except where the water was kept on late. I applied paris green on the first crop of worms faithfully, and perhaps the second crop may not appear in much force.

Yours truly,

C. Briggs.

North Rochester, July 30, 1883.

W. A. Stearns, Esq.

My Dear Sir, — Yours of the twenty-third received. A cranberry grower in Berkley lately wrote to me that his vines were being destroyed by worms, as they were last season.

I think I have hit upon a plan that will aid us in our investigations. It is to enclose a small patch of vines with boards, covered with netting, and confine under it a suitable number of larvæ so that they can have light and moisture without interfering with their natural habits. Thus they can be easily examined from time to time as they change from larvæ to chrysalids, and from chrysalids to moths, which lay their eggs upon vines within the enclosure. This will enable us to observe the moths, and determine the position and appearance of the eggs. I have the netting so arranged that it can, in a moment, be removed and glass substituted, so as to facilitate observation. The difficulty just now is to find larvæ enough for the experiment. Only seven could be found this morning after a careful examination of about three hours.

I have been expecting the second crop of worms to come in considerable force; but the application of paris green was so thorough that not many more worms may appear. Those that I now find are of the second crop, and their appearance has doubtless been delayed by late flowering. If they should come in any considerable numbers they will doubtless show themselves within a week.

I am doubtful as to the best time for you to be here. As the eggs of the second crop of worms are now beginning to hatch, it is possible that you may find the eggs and the young worms just at the time they were hatched, if you were here now.

Very truly yours,

C. Briggs.

The next letter showed the best of results from the doctor's treatment of his vines, though I do not recommend the method, on general principles. It is simply a note, dated August 9, and says: —

"The second crop of the vine worm has not appeared, and I do not think it will this season. The paris green seems to have been used very effectively."

Later, under date of September 3, he says: —

"Did you see in the appendix to 'White's Cranberry Culture, the 'Report of William C. Fish to the Cape Cod Cranberry Growers' Association in 1869?' This report treats of the 'Vine Worm, Fruit Worm, Black Span Worm, and the Cecidomyia or Gall Gnat of the Cranberry.' He says of the eggs of the vine worm: 'These eggs are a flat, circular scale, of a honey-yellow color, and measure about three one-hundreths of an inch in diameter. It was a common opinion that the eggs were laid in the bud, but I have never been able to find one there, and have yet to meet with a person who has found one on that part of the plant. I have seen hundreds of the eggs and never one but it was on the under side of the leaf.'"

Corresponding later, personally, with Mr. Nathaniel Robbins of Harwich, I received the following interesting letter: —

Harwich, August 29, 1883.

Mr. W. A. Stearns.

Dear Sir, — Yours of the twenty-fifth received. I have not been successful with my cranberry crop this year. I flowed my bog the

fourteenth of June, and destroyed most of the vine or fire worms, as we call them. My bog came forward and blossomed, and put out abundantly, and looked fair for a large crop, until the first part of August, when the fruit worms made their appearance, and have since then destroyed three-fourths of my crop, and are still eating. The vine or fire worm has been very destructive on the Cape this season. I think the crop will be small.

Yours truly,

NATHANIEL ROBBINS.

In correspondence with Mr. Cyrus Cahoon, whom, I am informed, is one of the large cranberry growers upon the Cape, I received the following: —

PLEASANT LAKE, Aug. 28, 1883.

W. A. STEARNS, Esq.

MY DEAR SIR: — Yours of the twenty-fifth inst., in relation to my success in fighting the cranberry worm this fall, came safe to hand, and in reply will say, that I do not know whether it is the vine worm, that we have to contend very strongly with in the first part of the season, or whether it is the fruit worm that makes its appearance later, and that has very seriously injured our cranberry crops this present season, that you wish to know about. I will say, however, that I have never had such a fight with the vine worm as my neighbors have had, for I have always had water at my control until the last eighteen months, and therefore could prevent their ravages at once, without trouble or expense. But in the spring of '82 the water was not sufficiently high to flow my vines, therefore I was at the mercy of the worms; but they eat or destroyed but a small part of my vines, and I had a good crop; but in the spring of 1883, — the water still too low, — the worms increased very much from last year and injured my vines quite seriously, and I did not make any attempt to prevent them. I shall not dare to risk my crop another season, but shall apply a solution of tobacco, providing the water is not of a sufficient height to flow my vines. I watched my neighbors very closely the first part of the past worm season, and found them very successful in the application of tobacco. They applied the solution with a garden force-pump at the time of the worms first making their appearance. It is often the case, however, that the second, and if very rainy weather, the third application is necessary. As for the fruit worm, I do not think it possible to prevent them from eating our berries. The egg is deposited by a miller. The larva, immediately upon hatching, makes an incision upon the upper side of the berry near the stem; the

incision closes immediately, and the berry becomes sound and glossy while the larva is perfectly secure, until the worm consumes the best part of the berry and leaves it for another: then only can he be reached by water, provided a head of water is accessible. But there is no advantage gained, as the whole crop will most assuredly be destroyed by the water at the season of the year when the worms are doing the mischief.

Very truly yours, CYRUS CAHOON.

This letter of Mr. Cahoon's is very valuable, and would seem to settle one point; namely, that tobacco-water has in some instances killed the worm, after repeated applications.

BERKLEY, Sept. 3, 1883.

Mr. W. A. STEARNS.

DEAR SIR: — Yours of the twenty-fifth is at hand. I have been troubled with the vine worms but two years, and cannot say much about them. The last two years they have destroyed my crops. One of my bogs is now full of berries. I have given this bog attention this summer, by flowing often, and have nearly destroyed the worms, but there are some of them at work where the water did not reach. I have been at a loss to know what kind of a worm I have had, and can hardly find the fellow. I have found, by close searching, another kind of worm from that shown me by Dr. Briggs, that was not so small and active. What Dr. Briggs showed me as the vine worm, he tells me cannot be easily caught, and that they drop off the vine to the ground or foliage as soon as disturbed; this may account for my not being able to find them, as the foliage of my vines is much larger than that of his." [Mr. Babbitt mentions finding the cranberry span-worm damaging his bogs: it is probably a species of *Cidaria*, and undoubtedly the same mentioned by Prof. Packard, p. 326, of his "Guide," as "A larva, probably of Cidaria, has been found by Mr. W. C. Fish stripping the cranberry plants in Harwich, Mass., late in August." He also mentions finding another larvæ, "large and greenish, say three-fourths of an inch long." From this indefinite description I would not attempt to even guess at its identity. With regard to the vine worm he continues]: "If I am troubled with them another year I shall use paris green, for I think this is the best remedy. One of my meadows was destroyed or eaten this summer, the work being done in four or five days during my absence, so that it is necessary to keep an eye to them every day.

Respectfully,

WILLIAM BABBITT.

In communication with Dr. Briggs the following interesting items were learned : —

In North Rochester the first appearance of the vine worm in 1883 was on the 28th of May, and it continued there until the 13th of August. During this time the doctor had his vines examined *every day*, and sometimes twice a day.

The worms appeared very easily affected by any slight jar or concussion of the earth or foliage near them. When found crawling loosely upon the leaves, as they often were, if disturbed in the least they would immediately roll themselves up and drop to the ground. Thus making it very difficult for one to detect so small a creature actually at work upon the vines themselves.

The young worms were often found coming out of the involucre. They webbed up the leaves about where the bud was to appear, and then seemed to eat everything green within their enclosure. There they seemed to complete a sort of artificial cocoon, and to turn to the pupa or chrysalid state within it, from which they appeared in due time as the miller, who then laid its eggs for a new crop of worms. I am informed, that it takes a great deal of practice to enable one to find these worms, as they are so insignificant looking, and lie so well concealed within the foliage of the vines, — adding also the above-mentioned fact of their dropping off the vines at the slightest jar.

A cranberry bog is often regarded as something that will take care of itself, and needs little or no laying out and tending ; but so far is this from being the case, that some of our best bogs are laid out carefully in beds, well and evenly prepared, and trenched, with a near outlet or rather inlet from some brook or ditch, whence the water can be let on or off the meadow as desired. Such care was taken in spraying the vines that the spray was thrown over the plants with a watering-pot, and a little practice will soon enable the boys or men to cover every part. Even after the vines were flowed, the men went over the patch and sprinkled the tops of the vines remaining out of water. The solution used was a watery mixture of paris green. August 14th there was

scarcely a worm to be found anywhere upon the whole bog. The crop of berries was rather small but fair.

I would add, here, a word in favor of tobacco decoction for destroying these pests, and against paris green. The latter, being an arsenite of copper, some small portion of the arsenic *must* become more or less soluble; hence the danger attendant upon the free use of such a deadly compound even with the most careful manager.

In support of the theory that there might be five or even six species of worms attacking the cranberry, all of which bore certain resemblances to each other, but which were yet distinct species, I have examined the new work of Mr. William Saunders, on "Insects injurious to Fruits," and find that he there (p. 368, etc.) mentions four species of Tortrid moths as affecting the cranberry vines, and one as affecting the berry — making five in all; yet of one of these, described as *Teras oxycoccana*, (Pack.) or The Glistening Cranberry Moth, he says: "This moth, the larva of which *is said* to feed on cranberry vines;" and further on, "the caterpillar has not been described." It may not be doing injustice to the person originating the idea that this species feeds upon the cranberry vine, to suggest the possibility of mistaking for an injurious species one whose habits were not fully known, and whose caterpillar had not been fully identified; since many moths, probably in no way injurious, may alight, and often in large numbers, in a cultivated field of any kind; while the probability of identifying either moths with caterpillars, or *vice versa*, without most positive, close observation, if not actually rearing the larvæ, is very, very small. It is safe to say, then, that this species is a doubtful "pest" of the cranberry vine, at least until more evidence shall be shed upon it by some enthusiastic collector or investigator.

With regard to the other three species affecting the foliage, I believe still more uncertainty exists; of one thing, however, I am certain. I have examined between twenty and thirty caterpillars, old and young, sent me from Dr. Briggs' cranberry bog, and have found so complete a series varying in length from one-eighth to nearly one-half an inch; in color from greenish and bluish to pure or creamy

white; from head and fore feet black to head and fore feet amber, and even *dark* honey yellow, that I cannot but believe them to be all stages of the same species, so far as I have observed those sent me. I may mistake, though I greatly doubt it.

So far I have had most unfortunate luck in rearing either the "vine worm," or the "fruit worm." Of at least thirty larvæ of the vine worm, I have about three pupa, which show every sign of preparing to winter over, while I have not hatched a miller or secured its eggs, though a large box, filled with vines whose roots were kept continually moist with wet rags, was kept, into which a large number both of caterpillars and pupas were put, hoping that at least one might survive the miller state and lay its eggs.

A box of several hundred berries, whose interiors contained larvæ of the berry worm, as evinced from the partially or completely closed puncture in the side, succeeded no better, and September 14th, at the time of first drafting this page, not a sign of larva, pupa or miller is evident, while most of the berries have shrunk to dried pods, evidencing the work of the caterpillar even after the berries had been put into the box.

Of the tenacity of life of the vine worm I am assured, for a specimen in a box, which had escaped my attention, for a time, had concealed itself beneath a dry sprig of cranberry vine, and was alive, though in a torpid or benumbed state, nearly two months after it was placed there.

Under date of September 18th, I found that a box which contains cranberry vines, and did contain a large number of worms ("fire-worms") and cocoons, now has yielded a large number of eggs, of this species of worm, probably; they are flat and scale-like, of a yellow yolk surrounded by a whitish substance and placed singly upon the under side of the leaves, one or two upon each leaf. I await with impatience the time for them to hatch, which probably will not be till next spring, about May 20th or thereabouts.

I had intended summing up more carefully the conflicting histories of both these pests, the vine worm and the berry worm; but as will be readily seen from what has already been shown from the sum of our previous knowl-

edge, there is so much really important matter yet to be learned respecting the life-history of these animals, that until the subject has been more thoroughly investigated, a part of their history will remain yet incomplete. The above is the result of only a few days' work in a single locality. Another year would seem to promise still more important results; it is but natural that in fighting an enemy we should ascertain the assailable points.

It is natural that in some stages of growth this insect must be more easily gotten at than at others. If, now, we put forth an extra effort, follow up the attack, find out the complete life-history of these pests, we then shall be able to ascertain in what condition of their growth they are most easily destroyed, and applying our test remedies, find the one most suitable to destroy the pest, thus doing a practical good, and saving thousands of dollars to one of the industries of the State.

The Chairman. There is now an opportunity for discussing this important subject of cranberry growing. The Chair is very happy to notice in the hall some gentlemen engaged in this important industry. We would like to hear from Dr. Eldridge, who is a large cultivator.

Dr. Eldridge of Yarmouthport. I had no idea of being called upon to speak. I came here for the purpose of getting information upon the subject of cranberry culture, in addition to the enjoyment I anticipated from hearing the Secretary's lecture last night; and if I go back without very much information to communicate to my neighbors about cranberry growing, I am entirely satisfied with the result of my expedition to Lowell.

The people on the Cape, where I live, are devoting more and more attention to the cultivation of the cranberry. The climate there favors it. Being thrust off into the sea as far as we are, we have no extremely hot summers, and then the sweep of the Gulf Stream, coming not very far from us, prevents us from having extremely cold winters, so that we escape the frosts that are very injurious often to the cultivation of the cranberry elsewhere. Then the soil is favorable. You know cranberries do not object to sand in considerable quantities,

and we are enabled to treat them with sand to any extent, if they desire it. There are a great many ponds on the Cape, as there are in other pine-growing countries. I remember that in Sweden, and in some parts of Germany, where pines grow over large areas, there are fresh-water ponds in all directions, and we have them on the Cape. Large quantities of cranberries are raised around the edges of these ponds, where the slope is very gentle, so that the vegetable growth and decay gradually extend off towards the deep water. The cranberry growers remove the bushes, roll on some sand, and set their vines. Then there are a great many places all about there where there were once extensive ponds; lowlands which have been entirely covered over by the vegetable growth and decay of past ages. There will be at the bottom, probably where the old sand surface was, a hard-pan that will hold water up, and above it will be peat, which is a little more manageable, and a vegetable growth that is excellent for the roots of the berries. We roll our sand over the surface, after having ditched it off properly, and set our vines in rows fifteen inches apart, each hill fifteen inches from its neighbor at the corners; rake it down both ways, and put the hills down at the intersection of the teeth as we rake across.

There are two sorts of berries which are becoming more and more popular. One is what we call the early black berry, which comes into market before anything else, which is round, very shiny and lustrous in appearance, and escapes the frosts entirely in consequence of being ready for the market early; and then, coming into market before any other kind, we get better prices for it. Then there is a larger and lighter-colored berry, known in that region as the James P. Dennis berry, which brings a high price in the market. This variety is being extensively cultivated, and sent in different directions in this country and abroad.

When we get the vines set, then, of course, the fight is, in the first place, with the weeds. Keep them entirely clear of weeds for two years, the runners from those vines will begin to grow, and will extend five, six or seven feet in different directions and cover the surface all over. When they fairly get possession of the land, they will hold it against weeds. But unless you assist them in the outset by weeding, or by

flowing, the runners will not cover the ground, and you will have a good deal of trouble from weeds. There are various kinds of weeds that it is necessary should be killed by flooding. The weeding gives occasion for a great deal of hard labor.

I do not know anything scientifically about the insects, neither do my neighbors. We are hoping that the scientific people will get hold of some valuable information in regard to them. I have been very much interested indeed in the collection of facts that have been brought together from various places and presented here by our young friend from Amherst. We practical people find that there are about three periods of attack by these worms. The first settlers come along the latter part of May and continue into June; then, after an interval of about a month, we have another attack; and after an interval of another month, we have a third attack. The first and second attacks are upon the leaves and the stalks, and the last attack is on the berries. Some of the people, not being possessed of a great deal of scientific information, in consequence of the regularity of these intervals have an idea that all the mischief is done by different forms of the same insect; the slight differences in appearance and mode of action they refer to the law of progress, in the different stages of development, and perhaps they think they are referable also to the amount and kind of nourishment that is furnished these different sets of the same insects by nature, as they come on. I presume it is not so, but they have some such idea, and a good many intelligent people hold that opinion.

These worms are fought with water, letting the water on early and holding it on, and as it covers the bog over, where it is warm and the sun shines clearly, this insect will be hatched out and float on the surface, and be swept away by the wind. Where the water is deeper and colder, and in places where, perhaps, the sun has not such free access, there the water does not seem to promote the hatching of the eggs, and they will stay there, and the whole thing be checked by the water itself which is let on to destroy them. Usually, after the water is let on, the sun warms them up, and they will hatch out then. One lesson we have been taught is, to have our

bogs graded without deviation from a perfect level. I have one bog of about ten acres, where there is a difference of level of only four inches. That is for the purpose of having the water dry off of those eggs, and give them all a fair chance to be hatched by the sun and come to the surface, to be swept away when the water is warmed up.

Another mode of attacking them, which has been briefly referred to in the latter part of the report which has been kindly presented to us, is by the use of tobacco. We are using more and more of that, and I think if our friend pursues kindly, and for the public advantage, this investigation upon which he has entered, and for which he seems so well qualified, he will discover more and more of the efforts, and the successful efforts, that are being made for the destruction of these worms, particularly the two sets of "vine fire-worms," as we call them, by means of tobacco. We buy tobacco stumps by the bale — a bale costing seven or eight dollars, and weighing about five hundred pounds. Some have vats, in which they soak these stumps; some soak them in hogsheads; some boil them in copper kettles, putting, perhaps, a pound of these stumps into a gallon of water, and then sprinkle it on, either by means of an ordinary pot, with perforated openings, or else by means of hand force-pumps, such as are employed to wash windows. The stronger the solution, and the wetter the vines are left, of course, the better. The idea seems to be that the tobacco itself does not kill them, but that when the eggs hatch and the new insect begins to eat the leaf covered with tobacco, that is what does the business, the tobacco acting internally, rather than upon the surface of the insect. So that, if you happen to have a shower directly after the free use of tobacco, the chances are that the leaves will be washed clean, and you must try it over again. But the great point is, to be very observant. Those men are very observant and watchful, and the moment they find two of those little leaves at the top of the plant stuck together by some glutinous or adhesive substance that the worm seems to have the power of depositing, if they do not find but that one case, on goes the water; or, if they use tobacco, on goes the tobacco; and then, as the insects hatch, succeeding this one pioneer, of

course they begin to eat, and, eating, they obtain what we want to have them get.

That is about the substance of all I have to say in regard to the matter, gentlemen. If anybody has any question to ask, which a Cape Cod man, practically concerned in the thing, can answer in brief, of course I will be ready to answer it. I came in, as I said before, without any thought of addressing you, but simply to obtain information with regard to these insects and the general matter of cranberry culture.

Question. Will the doctor state distinctly whether that treatment is confined to the worm that preys upon the leaves only, or is it applied also to the berry worm?

Dr. Eldridge. They try it for the berry worm, but if they are pretty thoroughly successful in destroying the first set, they will not be troubled so much with the second set of vine fire-worms. And that is one reason for supposing that they are the same thing. Those unscientific people think that they are the same thing, progressively developing into different forms, and one evidence of it, as they say, is the fact, which they claim to be one, that if you are exceedingly thorough in your treatment of the second set, so that you kill that crop, you do not have any berry worms. They think they see the result of the destruction of the second crop in the non-appearance of the berry worm. I do not attach a great deal of consequence to that thought. I do not believe it is so myself.

Mr. Daniel Round. I am interested in the description given of the cranberry insects here. I have spent some time during the past fall in making cranberry meadows, and I am convinced, from my observations, that there are more than three kinds of insects that prey upon cranberry vines. I found, on overhauling some five hundred cranberry crates this fall, thousands of millers, of a large size, and of a grayish cast. They seemed to have been developed after the cranberries had been deposited in the cranberry house. I do not know what they are, but they were there, and they evidently have something to do with the cranberry business. I propose to look into that matter further.

I have also discovered in the vicinity of the meadow multitudes of very small, white millers, — more than I could begin

to enumerate. They seemed like fine snow-flakes. I should think the little millers did not measure more than an eighth of an inch across. The air was full of them in the vicinity of the vines, and I concluded that they were there for something. The description that we have had does not solve the problem. I have one meadow in the vicinity of the meadow of which I have been speaking, where the vines have been destroyed for two seasons. They will appear perfectly fair, with no particular signs of insect visitants one day, and in three days' time they are infested all over. I see but very few millers. It seems as though fire had gone over them, as I have seen a potatoe field when the fire-blight came upon it. They come and spread all over the vines at one time, and yet I am unable to discover a very large number of the miller. So I have come to the conclusion that we have not yet reached the bottom of this matter. I am very glad it has been introduced, and that remarks are being made upon it. I have found, universally, that the use of water has prevented the ravages of the fire-worm, — having abundance of water to use, and using it at the proper time.

There is one thing about this matter that I wish to be particularly noted, and that is, the difference in different sections. The doctor has been speaking of Cape Cod, and about their freedom from early frosts; but there are large cultivators of cranberries all over Massachusetts, in those sections where frosts are early, and where they are liable to have their vines destroyed. He has given us no definite time when the water should be drawn off in the spring, and the proper time to flow again after it is drawn off. We have practised this rule: to draw off the water on the first of May, and again raise the water on the twentieth of May and leave it on four days; and never, when we have been able to do that, have we been troubled with any vine insects, or seen any of them. It has resulted just in that way with us, and we follow that rule universally.

I found that what is called "the berry worm" operated very extensively last season all over Norfolk County and probably in other counties, but I found that they operated generally where there had been no winter flowage. One of our dams broke away and let the water down last winter,

and it was not raised again, and the consequence was, that perhaps a hundred barrels of cranberries were destroyed by the ravages of the berry worm. I know of one section where very many barrels were picked last year, and none at all this year; they were all destroyed by the berry worm. The dam was washed away, the water lowered, and we did not have the advantage of continuous winter flowage. I suppose, as the dams have been secured and made properly tight, this will be prevented the coming season.

I have noticed another thing in watching these insects, and that is, that the larvæ of the berry worm deposit their eggs where they are; they do not go up on the banks at all. They deposit their eggs and go into the chrysalis stage in the same place. I never find them crawling away and getting up the banks; and consequently I believe, if the meadow is properly flowed, of sufficient depth, during the winter, we shall have but little trouble from the worm during the coming season.

I speak of the meadows of Norfolk County, not of Cape Cod, and I know that the cranberry growers there have come to the conclusion, very generally, that the remedy for this worm is to flow their lands during the winter, and many of them have been to considerable expense for extra means of flowing.

Question. Would not paris green destroy them?

Mr. Round. I think very likely Paris green would answer the purpose, but I should not recommend anything of that kind for general use. I understand that the department at Washington sent some gentlemen all over the Cape to investigate this matter, and that Mr. Russell will recommend, in his forthcoming report, something that is better than paris green and better than tobacco for that purpose. If he or any man can discover a remedy for this destructive insect, he will be entitled to the gratitude of every cranberry grower, for some men have lost twenty thousand dollars some seasons by the almost total destruction of their crops; but a different treatment should be given to meadows in Norfolk County from that given to those on the Cape, where they are not troubled with frosts. They have some enemies

there, and we in other parts of the State have others, where we are exposed to danger from frosts.

Mr. Davis of Martha's Vineyard. I was a little surprised, Mr. Chairman, when I saw our honorable Secretary call your attention to myself, because he must know that I know little about the culture of the cranberry, although I come from a district where it is one of the chief crops. I can say very little, and add nothing whatever to what has been said, except that down on the Vineyard we use water for the cranberry as much as possible; but this year, especially, where we have had plenty of water, the use of which heretofore has been perfectly successful, this year it has amounted to nothing whatever. Our bogs were flowed in the fall; the water was kept on until about the tenth of April; then it was drawn off, and by the first of June the most of our people saw some evidence of this vine worm, and flowed again, as was customary, and with no success whatever; our crop was almost an absolute failure. Those who have adopted, to a certain extent, the use of a tobacco solution, were more successful this year than those who adopted the use of water.

Mr. Round. From your statement, I infer that they did not regard the time when the water was drawn off and let on again as of any consequence, but simply watched for the appearance of the insect. Now, these larvæ will appear in about so many days after the water is taken off, and if the growers do not observe that, they are liable to lose their crop, as a matter of course.

Mr. Davis. That does not explain the difficulty. They were not successful this year, and have been heretofore, with the same treatment.

Mr. Round. Let me ask whether the lecturer intends to pursue his investigation? I really hope it will be done. I do not know that the Board can do anything about it particularly, but it will be gratifying to those interested in the cultivation of the cranberry to know that he intends to pursue it.

Secretary Russell. At the last meeting of the Board, this matter was brought before us and it was referred to the Experiment Station. Mr. Round made the motion. It is

now before the Station, and there will be a report when sufficient information has been obtained to make a basis.

Mr. Round. The reason I asked the question was, that the cranberry growers here might understand that this matter was being examined by the Experiment Station, and that any items of information they can gather will help the matter materially.

The Chairman. The Chair has no doubt that the Board of Agriculture and the Board of Control of the Experiment Station will pursue this matter to the end, and give to the people throughout the State all the information they can relating to the cranberry worm.

Mr. Grinnell. I beg the attention of the members of the Board particularly for one moment. It has been customary at these meetings to offer some resolution recognizing the courteous attentions which we have received in the cities and towns which we have visited. We have had here most agreeable meetings; we have had full meetings,— not so full in the evening as we have had in the country proper,— and we have been treated with great courtesy. I therefore wish to offer the following resolutions: —

Resolved, That the thanks of the Board of Agriculture be tendered to the citizens of Lowell, and particularly to Mr. Ludlam, the agent of the Merrimack Mills, and to Major Emery, of the Merrimack House, for courtesies shown to the members of the Board at the country meeting just passed.

This resolution was adopted unanimously.

Resolved, That the thanks of the Board of Agriculture be tendered to the Old Colony Railroad for their courtesy in furnishing free return tickets to those attending this meeting, coming over any of the lines of their road.

Mr. Moore. I think that it is only justice to the Fitchburg Railroad that that road should be included in the resolution, as they have always extended the same courtesy over the line of their road.

Secretary Russell. The gentleman will permit me to say, that I hope the Old Colony Railroad will be especially

mentioned for their continued courtesies to us. I will add, that I have never had occasion to ask the Fitchburg Railroad to do anything for us that they have not cheerfully accorded. The Old Colony road furnished me early with tickets over every part of their road, and they have always done so. I think they should be mentioned, and we have mentioned the Fitchburg Railroad in the same terms at a previous meeting.

The resolution was adopted, and, on motion of Mr. WARE, the meeting adjourned, *sine die*.

ANNUAL MEETING OF THE BOARD.

ANNUAL MEETING OF THE BOARD.

The Board met at the office of the Secretary, in the new rooms, Commonwealth Building, in Boston, Tuesday, February 5, 1884, at twelve o'clock, Hon. Marshall P. Wilder in the chair.

Present: Messrs. Bird, Bowditch, Buell, Damon, Davis, Edson, Farnsworth, Grinnell, Goodrich, Haskell, Hersey, Hill, Lane, Lynde, McKinstry, Moore, Nye, Noble, Round, Slade, Smith, Varnum, Ware, Warner, Waterman, Wheeler and Wilder.

Voted, To dispense with the reading of the minutes of the last meeting, the matter having all been printed in the annual report for 1883.

Voted, To meet each day of the session at 9.30 o'clock A. M., and to adjourn for one hour and a half, from 1 to 2.30 o'clock P. M.

Voted, To appoint a committee of three to examine and report on the credentials of newly-elected members: Messrs. Damon, Bird and Round.

Reports of delegates to the annual fairs being in order, — Mr. Bird reported on the Amesbury and Salisbury, Mr. Round reported on the Barnstable, Mr. Farnsworth reported on the Deerfield Valley, Mr. Wheeler reported on the Hampden East, Mr. Hersey reported on the Hampshire, Mr. Damon reported on the Hampshire, Franklin and Hampden.

Mr. Wilder here addressed the Board on the importance of proper nomenclature of fruits, and Mr. Slade moved that the subject be made the order of the day to-morrow at 10 A. M.

Adjourned for one hour and a half.

Met at 2.30 P. M., Mr. Grinnell in the chair.

Reports on the annual fairs were continued: Mr. Noble reported on the Bristol, Mr. Haskell reported on the Hoosac Valley, Mr. Buell reported on the Housatonic, Mr. Russell reported on the Hampden, Mr. Warner reported on the Marshfield, Mr. Smith reported on the Essex, Mr. Lane reported on the Middlesex, Dr. Lynde reported on the Middlesex North, Mr. Goodrich reported on the Middlesex South, Mr. Ware reported on the Worcester, Mr. Slade reported on the Plymouth, Mr. McKinstry reported on the Worcester North-west.

The Committee on Credentials, to which was referred the credentials of newly-elected members, respectfully report that they have attended to that duty and find the following duly elected: —

James S. Grinnell, appointed by the Executive.
John Lane of East Bridgewater, by the Plymouth Society.
S. B. Bird of Framingham, by the Middlesex South.
Wm. L. Bowen of Peru, by the Highland Society.
J. Henry Goddard, by the Worcester West Society.
Alvan Barrus, by the Hillside Society.
Avery P. Slade, by the Bristol Society.
Calvin L. Hartshorn, by the Worcester Society.
Arthur A. Smith, by the Deerfield Valley Society.
Edwin A. Goodrich, by the Worcester North Society.

The report was accepted.

The reports on the annual fairs were laid on the table.

Mr. Hersey read an essay upon "Preparation of the soil for the growth of crops."

Voted, That the morning session begin at 10 o'clock instead of 9.30 o'clock.

A communication was received from James Draper, Master of the Massachusetts State Grange of the Order of Patrons of Husbandry, which was read and laid on the table.

Mr. Haskell read an essay upon "Corn Culture."

After an interesting discussion, this essay was laid on the table.

The meeting adjourned to 10 o'clock on Wednesday.

SECOND DAY.

The Board met at ten o'clock A. M., Mr. GRINNELL in the chair.

Present: Messrs. Barrus, Bird, Bowditch, Bowen, Buell, Buddington, Davis, Damon, Edson, Goddard, Grinnell, Hadwen, Haskell, Hartshorn, Hersey, Hill, Lane, Lynde, McKinstry, Moore, Nye, Noble, Round, Slade, Smith, Varnum, Ware, Warner, Waterman, Wheeler and Wilder.

Messrs. Warner, Damon and Buddington were appointed a Committee upon the Assignment of Delegates to the Fairs.

Messrs. Slade, Smith, Bowditch, Hartshorn and Noble were appointed a Committee upon the time and place for holding the Country Meeting.

Messrs. Wheeler, Nye and Edson were appointed a Committee upon the Changes of Times for holding the Fairs.

The business assigned for the morning hour, the proper nomenclature of fruits, was then presented by Mr. Wilder, President of the American Pomological Society, and by his request the following extract from his annual address before that society was read by the Secretary: —

"In former addresses, I have spoken to you of the importance of the establishment of short, plain and proper rules to govern the nomenclature and description of our fruits, and of our duty in regard to it; and I desire once more to enforce these opinions on a subject which I deem of imperative importance. Our Society has been foremost in the field of reform in this work, but there is much yet to be done. We should have a system of rules consistent with our science, regulated by common sense, and which shall avoid ostentatious, indecorous, inappropriate and superfluous names. Such a code your Committee have in hand, and I commend its adoption. Let us have no more Generals, Colonels or Captains attached to the names of our fruits; no more Presidents, Governors or titled dignitaries; no more Monarchs, Kings or Princes; no more Mammoths, Giants or Tom Thumbs; no more Nonesuches, Seek-no-furthers, Ne plus ultras, Hog-pens, Sheep-noses, Big Bobs, Iron Clads, Legal Tenders, Sucker States or Stump-the-World. Let us have no more long, unpronounceable, irrelevant, high-flown,

bombastic names to our fruits, and, if possible, let us dispense with the now confused terms of Belle, Beurre, Calebasse, Doyenne, Pearmain, Pippin, Seedling, Beauty, Favorite and other like useless and improper titles to our fruits. The cases are very few where a single word will not form a better name for a fruit than two or more. Thus shall we establish a standard worthy of imitation by other nations, and I suggest that we ask the co-operation of all pomological and horticultural societies, in this and foreign countries, in carrying out this important reform.

"As the first great national Pomological Society in origin, the representative of the most extensive and promising territory for fruit culture of which we have any knowledge, it became our duty to lead in this good work. Let us continue it, and give to the world a system of nomenclature for our fruits which shall be worthy of the Society and the country, — a system pure and plain in its diction, pertinent and proper in its application, and which shall be an example, not only for fruits, but for other products of the earth, and save our Society and the nation from the disgrace of unmeaning, pretentious and nonsensical names to the most perfect, useful and beautiful productions of the soil the world has ever known."

Voted, On motion of Mr. Moore, that in the nomenclature of fruits the various county societies are recommended to conform to the catalogue of the American Pomological Society in its exhibitions and publications, as suggested in President Wilder's address.

Mr. Russell read Mr. Taft's report on the Berkshire Society, Mr. Buddington reported on the Worcester South Society, Mr. Varnum reported on the Nantucket Society, Mr. Bowditch reported on the Worcester West Society, Mr. Hadwen reported on the Worcester North Society.

These reports were laid on the table.

Messrs. Lynde, Varnum and Goddard were appointed a Committee on Essays.

The Secretary called the attention of the Board to the attempt of the Worcester South-east Society to dissolve their corporation, and to the fact that a new society under the name of the Blackstone Valley Society was seeking incorporation from the Legislature.

Voted, That the matter be laid upon the table.

Mr. Grinnell reported on the Martha's Vineyard Society.

This report was referred to the Committee on Printing.

The Board received, by Delegate Wheeler, an application from the Commissioner of the Bureau of Statistics, for a hearing upon the matter of the State Census.

Voted, That the Commissioner be notified to appear at 2.30 o'clock P. M. and have half an hour to present his views.

On motion of Mr. Ware, Mr. Smith's report on the Essex Society was taken from the table and discussed.

The Board then adjourned for one hour and a half.

The Board was called to order at 2.30 o'clock by the Chairman.

Mr. Carroll D. Wright, Commissioner of the Bureau of Statistics, then addressed the Board on the importance of a better method for securing accurate agricultural statistics of the Commonwealth, and suggested that the estimate of crops should be made in the autumn months instead of in the spring.

On motion of Mr. Moore it was: *Resolved*, That it is the opinion of the Board of Agriculture that the best time to take the Agricultural Census of the Commonwealth is from the fifteenth of November to the first of the following January.

Mr. Buddington reported on the Franklin Society; Mr. Sessions reported on the Highland Society,

Messrs. Smith, Wheeler and Slade were appointed a committee to report to the Board five names of members to compose an Executive Committee who shall also be a Committee on Printing.

The Board then proceeded to elect a Secretary for one year, by ballot. John E. Russell was chosen.

The report of the Director of the Experiment Station was offered, with the reports in detail of his subordinates.

Voted, That the Board of Control have further time to complete their report, with instruction to present it to the Secretary in time for printing in the annual report.

The Committee on names to compose an Executive Committee that shall also be a Committee on Printing, reported Messrs. Wilder, Moore, Hersey, Slade and Bowditch, who were accepted.

Voted, That the Executive Committee have power to change the day or days of holding fairs of any societies for that year.

Prof. Goessmann, State Inspector of Fertilizers, submitted his Eleventh Annual Report, which was accepted.

ELEVENTH ANNUAL REPORT ON COMMERCIAL FERTILIZERS.

BY C. A. GOESSMANN, STATE INSPECTOR.

The trade in commercial fertilizers has been quite active during the past year. The number of manufacturers of fertilizers has somewhat increased within the State on account of the establishment of small factories to convert various kinds of local valuable animal refuse materials into compound manures. None of our large manufacturers, whose names are familiar to the farming community, have withdrawn from our markets. No sudden serious fluctuations of prices in the wholesale market have been noticed during the year. Nitrogen and phosphoric acid have been offered of late at less cost than during the earlier part of the season; whilst the higher grades of potassa have been sold quite frequently at a somewhat advanced price, as compared with previous years.

The present low price of nitrate of soda and the more economical and cheaper production of sulphuric acid tend to reduce prices. Whether these changes will benefit the farmer depends largely on the management of the retail

trade. High charges of retail agents and a long credit system quite frequently deprive the farmer of the benefits arising from a more skilful manufacture of fertilizers and a better commercial management of the various resources of the crude materials which serve for the production of the former. The composition of the majority of the more prominent standard fertilizers, as a rule, has been but little altered, and on the whole but few causes of complaint have been reported, regarding that class of articles.

Whenever changes have been made the tendency has been to reduce the nitrogen and to increase the potassa. Nitrate of soda has been more frequently used as a part of the nitrogen resources in complete manures.

The late comparative high price of the better quality of nitrogenous animal refuse matter and the temporary low cost of nitrate of soda have apparently favored these changes. As purely commercial considerations cannot fail to exert an influence on the manufacturer of fertilizers regarding the choice of material and the manner of compounding their formulas, it seems but proper that farmers should benefit by their experience in the past and devise some practical way by which they can secure fertilizers which are compounded with reference to their special wants.

It is gratifying to notice the steadily increasing call for agricultural chemicals, — for it is a practical demonstration of our progress in a rational system of manuring farm lands. Fertilizers pay only when applied with reference to the existing deficiency in plant-food in the soil; and in a general farm management are most valuable when merely supplementing home-made manures.

The subsequent statement of prices refers to the past year. They have been used in the valuation of the fertilizers described in this report, which contains the analyses of eighty-seven samples: —

	Cost per pound, in cents.
Nitrogen. In form of nitrates,	20
In form of ammonia salts,	26
In Peruvian guano, fine steamed bone, dried ground meat and blood, fine ground fish, urates, poudrettes, superphosphates and special manures,	23
In fine ground bone and bat-guano,	17
In tankage, cotton-seed, linseed and castor pomace,	18
In animal refuse, wool waste, barnyard manure, fish scraps and refuse from glue factories and tanneries,	11
Phosphoric Acid soluble in water. As in alkaline phosphates and superphosphates,	11
In so-called reduced or reverted acid, peruvian guano and urates,	8
In precipitated bone-phosphate, steamed fine bone, fish guano, according to size and disintegration, from	6–7
In bone-black waste, wood ash, ground bone ash, coarse ground bone, poudrette, barnyard manure, etc.,	4
In fine ground rock phosphates,	2¾
Potassium Oxide. In muriate of potash or chloride of potassium,	4¼
In sulphate of potassa in natural and artificial kainits,	4¼
In higher grades of sulphate of potassa,	7

I. — Salines.

Muriate of Potash.

I. Collected of G. P. Smith, Sunderland, Mass.

II. Quinnipiac Fertilizer Co., New London, Ct.; collected of E. T. Sabin, East Amherst, Mass.

	I.	II.
Moisture at 100° C.,	2.85 per cent.	2.89 per cent.
Potassium oxide,	50.59 "	50.05 "
Sodium oxide,	8.40 "	8.30 "
Magnesium oxide,	trace, "	.60 "
Sulphuric acid,	trace, "	.28 "
Calcium oxide,		
Insoluble matter,	1.50 "	.15 "
Valuation per ton,	$43.00	$42.54

Nitrate of Soda.

(Collected of D. A. Horton, Northampton, Mass.)

	Per cent.
Moisture at 100° C.,	1.25
Nitrogen,	15.57
Insoluble matter,	.45
Valuation per two thousand pounds,	$62.28

Ammonium Sulphate.

(Collected of G. P. Smith, Sunderland, Mass.)

Guaranteed composition: Ammonia 24 to 25 per cent. (equivalent to nitrogen 19.75 to 20.50 per cent.).

	Per cent.
Moisture at 100° C.,	0.23
Ammonia (equivalent to nitrogen, 20.4),	24.80
Sulphuric acid,	61.60
Insoluble matter,	.05
Valuation per two thousand pounds,	$106.08

Green Mountain Odorless Fertilizer.

(Geo. W. Maynard, Lawrence, Mass. Sent on from Salem, Mass.)

	Per cent.
Moisture at 100° C.,	19.40
Calcium oxide,	33.39
Sodium oxide,	7.55
Magnesium oxide,	2.47
Potassium oxide,	.44
Ferric oxide,	1.03
Phosphoric acid,	1.37
Chlorine,	7.69
Sulphuric acid,	2.61
Insoluble matter,	5.15

This article consists of ashes, salt and lime, and corresponds well with a sample tested during the past year.

II. — Fish and Fish-Potash.

Dry Fish.

(Geo. W. Miles' Co., Milford, Ct.; collected of P. F. Bridges, South Deerfield Mass.)

Guaranteed composition: nitrogen 7 to 10 per cent.

	Per cent.
Moisture at 100° C.,	7.63
Total phosphoric acid,	6.48
Soluble phosphoric acid, Reverted phosphoric acid,	2.16
Insoluble phosphoric acid,	4.32
Nitrogen,	8.65

Valuation per two thousand pounds: —

43.2 pounds of reverted phosphoric acid,	$3 46
86.4 pounds of insoluble phosphoric acid,	5 18
173. pounds of nitrogen,	39 79
	$18 43

Chittenden's Dry Ground Fish.

(National Fertilizer Co., Bridgeport, Ct.; collected of J. A. Sullivan, Northampton, Mass.)

Guaranteed composition: total phosphoric acid 6 to 8 per cent.; ammonia 8 to 10 per cent (equivalent to nitrogen 6.5 to 8.3 per cent.).

	Per cent.
Moisture at 100° C.,	10.78
Total phosphoric acid,	6.58
Soluble phosphoric acid, Reverted phosphoric acid,	3.00
Insoluble phosphoric acid,	3.58
Nitrogen,	7.20
Insoluble matter,	2.48

Valuation per two thousand pounds: —

60. pounds of reverted phosphoric acid,	$4 80
71.6 pounds of insoluble phosphoric acid,	4 30
144. pounds of nitrogen,	33 12
	$12 22

Dry Fish.

(Quinnipiac Fertilizer Co.; collected of E. T. Sabin, East Amherst, Mass.)

Guaranteed composition: total phosphoric acid, 6 to 8 per cent.; soluble and reverted phosphoric acid (available), 2 to 4 per cent; nitrogen, 7 to 9 per cent.

	Per cent.
Moisture at 100° C.,	9.45
Total phosphoric acid,	8 39
Soluble phosphoric acid, Reverted phosphoric acid,	2.75
Insoluble phosphoric acid,	5.64
Nitrogen,	8.85

Valuation per two thousand pounds: —

55. pounds of reverted phosphoric acid,	$4 40
112.8 pounds of insoluble phosphoric acid,	6 77
177. pounds of nitrogen,	40 71
	$51 88

Bowker's Dry Fish.

(Collected of C. T. Brown, Northampton, Mass.)

Guaranteed composition: ammonia 10 to 12 per cent. (equivalent to nitrogen 8.3 to 9.9 per cent.).

	Per cent.
Moisture at 100° C.,	9.02
Total phosphoric acid,	8.07
Soluble phosphoric acid, / Reverted phosphoric acid,	3 68
Insoluble phosphoric acid,	4.39
Nitrogen,	8.32
Insoluble matter,	3.25

Valuation per two thousand pounds: —

73.6 pounds of reverted phosphoric acid,	$5 89
87.8 pounds of insoluble phosphoric acid,	5 27
166.4 pounds of nitrogen,	38 27
	$19 43

Dry Fish Guano (C. Island).

(Geo. W. Miles' Co., Milford, Ct.; collected of D. F. Wright, Northampton, Mass.)

Guaranteed composition: bone phosphate 10 to 14 per cent. (equivalent to phosphoric acid 4.58 to 6.41 per cent.); ammonia 6 to 8 per cent (equivalent to nitrogen 4.9 to 6.7 per cent.).

	Per cent.
Moisture at 100° C.,	18.96
Total phosphoric acid,	7.98
Soluble phosphoric acid,	2.18
Reverted phosphoric acid,	3.54
Insoluble phosphoric acid,	2.26
Potassium oxide,	2.36
Nitrogen,	3.87
Insoluble matter,	2.85

Valuation per two thousand pounds: —

43 6 pounds of soluble phosphoric acid,	$4 80
70.8 pounds of reverted phosphoric acid,	5 66
45.2 pounds of insoluble phosphoric acid,	2 71
47.2 pounds of potassium oxide,	2 01
77.4 pounds of nitrogen,	17 80
	$32 98

Fish Pomace.

(Geo. W. Miles' Co., Milford, Ct.; collected of P. F. Bridges, South Deerfield, Mass.)

	Per cent.
Moisture at 100° C.,	38.11
Total phosphoric acid,	7.49
Soluble phosphoric acid,	.82
Reverted phosphoric acid,	2.87
Insoluble phosphoric acid,	3.79
Nitrogen,	5.43

Valuation per two thousand pounds: —

16.4 pounds of soluble phosphoric acid,	$1 80
57.4 pounds of reverted phosphoric acid,	4 59
75 8 pounds of insoluble phosphoric acid,	4 55
108.6 pounds of nitrogen,	24 98
	$35 92

Fish Pomace.

(Collected of H. L. Phelps, Northampton, Mass.)

	Per cent.
Moisture at 100° C,	44.41
Total phosphoric acid,	5.83
Soluble phosphoric acid,	1.57
Reverted phosphoric acid,	.64
Insoluble phosphoric acid,	3.62
Nitrogen,	5.27

Valuation per two thousand pounds: —

31.4 pounds of soluble phosphoric acid,	$3 45
12.4 pounds of reverted phosphoric acid,	99
72.4 pounds of insoluble phosphoric acid,	4 34
105.4 pounds nitrogen,	24 24
	$33 02

Fish and Potash. [*s*]

(Geo. W. Miles' Co., Milford, Ct.; collected of D. J. Wright, Northampton, Mass.)

Guaranteed composition: soluble and roverted phosphoric acid (available), 5 to 8 per cent.; potassium oxide, 4 to 6 per cent.; ammonia, 4 to 6 per cent. (equivalent to nitrogen, 3.3 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	15.60
Total phosphoric acid,	7.51
Soluble phosphoric acid,	4.88
Reverted phosphoric acid,	.07
Insoluble phosphoric acid,	2.56
Potassium oxide,	4.52
Nitrogen,	2.70
Insoluble matter,	3 30

Valuation per two thousand pounds: —

97 6 pounds of soluble phosphoric acid,	$10 74
1 4 pounds of reverted phosphoric acid,	11
51.2 pounds of insoluble phosphoric acid,	3 07
90.4 pounds of potassium oxide,	3 84
54. pounds nitrogen,	12 42
	$30 18

Fish and Potash.

(Geo. W. Miles' Co., Milford, Ct.; collected of P. F. Bridges, South Deerfield, Mass.)

Guaranteed composition: total phosphoric acid, 5 to 8 per cent.; potassium oxide, 3 to 5 per cent.; nitrogen, 2.5 to 3.5 per cent.

	Per cent.
Moisture at 100° C.,	27.69
Total phosphoric acid,	4.52
Soluble phosphoric acid, / Reverted phosphoric acid,	1.14
Insoluble phosphoric acid,	3.38
Potassium oxide,	2.57
Nitrogen,	2.77
Insoluble matter,	2.00

Valuation per two thousand pounds: —

22.8 pounds of reverted phosphoric acid,	$1 82
67.6 pounds of insoluble phosphoric acid,	4 06
51.4 pounds of potassium oxide,	2 18
55.4 pounds of nitrogen,	12 74
	$20 80

Fish and Potash.

(Geo. W. Miles' Co., Milford, Ct.; collected of P. F. Bridges, South Deerfield, Mass.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 5 to 8 per cent.; potassium oxide, 4 to 6

per cent.; ammonia, 4 to 6 per cent. (equivalent to nitrogen, 3¼ to 5 per cent.).

	Per cent.
Moisture at 100° C.,	13.78
Total phosphoric acid,	7.57
Soluble phosphoric acid,	3.44
Reverted phosphoric acid,	1.50
Insoluble phosphoric acid,	2.63
Potassium oxide,	4.59
Nitrogen,	3.63
Insoluble matter,	2.75

Valuation per two thousand pounds: —

68 8 pounds of soluble phosphoric acid,	$7 57
30. pounds of reverted phosphoric acid,	2 40
52.6 pounds of insoluble phosphoric acid,	3 16
91.8 pounds of potasium oxide,	3 90
72.6 pounds of nitrogen,	16 70
	$33 73

Fish and Potash (No. One).

(Quinnipiac Fertilizer Co., New London, Ct.; collected of E. T. Sabin, East Amherst, Mass.)

Guaranteed composition: total phosphoric acid, 5 to 7 per cent.; soluble and reverted phosphoric acid (available), 3 to 5 per cent.; insoluble phosphoric acid, 2 per cent.; nitrogen, 3.25 to 4.25 per cent.; potassium oxide, 3 to 5 per cent.

	Per cent.
Moisture at 100° C.,	19.67
Total phosphoric acid,	7.90
Soluble phosporic acid,	.50
Reverted phosphoric acid,	5.50
Insoluble phosphoric acid,	1.90
Potassium oxide,	4 30
Nitrogen,	3.73
Insoluble matter,	.93

Valuation per two thousand pounds: —

10. pounds of soluble phosphoric acid,	$1 10
110. pounds of reverted phosphoric acid,	8 08
38. pounds of insoluble phosphoric acid,	2 28
86. pounds of potassium oxide,	3 66
74.6 pounds of nitrogen,	17 16
	$32 28

Chittenden's Fish and Potash (No. Two.)

(Collected of Wilder and Puffer, Springfield, Mass.)

Guaranteed composition: total phosphoric acid, 6 to 8 per cent.; potassium oxide, 4 to 6 per cent.; ammonia, 2 to 4 per cent. (equivalent to nitrogen, 1.6 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	12.43
Total phosphoric acid,	6 84
Soluble phosphoric acid,	.13
Reverted phosphoric acid,	2.19
Insoluble phosphoric acid,	4.52
Potassium oxide,	4.72
Nitrogen,	1.90
Insoluble matter,	.55

Valuation per two thousand pounds: —

2.6 pounds of soluble phosphoric acid,	$0 29
43.8 pounds of reverted phosphoric acid,	3 50
90.4 pounds of insoluble phosphoric acid,	5 42
94.4 pounds of potassium oxide,	4 01
38. nitrogen,	8 74
	$21 96

Bowker's Fish and Potash.

(Collected of Fuller and Newton, Springfield, Mass.)

Guaranteed composition: total phosphoric acid, 8 to 10 per cent.; potassium oxide, 4 to 6 per cent.; nitrogen, 2.25 to 3.25 per cent.

	Per cent.
Moisture at 100° C.,	11.90
Total phosphoric acid,	11.92
Soluble phosphoric acid,	3.32
Reverted phosphoric acid,	2.90
Insoluble phosphoric acid,	5.70
Potassium oxide,	3.86
Nitrogen,	3.02
Insoluble matter,	6.85

Valuation per two thousand pounds: —

66.4 pounds of soluble phosphoric acid,	$7 30
50. pounds of reverted phosphoric acid,	4 f4
114. pounds of insoluble phosphoric acid,	6 84
77.2 pounds of potassium oxide,	3 28
60.4 pounds of nitrogen,	13 89
	$35 95

Chittenden's Fish and Potash.

(National Fertilizer Co., Bridgeport, Ct.; collected by J. A. Sullivan, Northampton, Mass.)

Guaranteed composition: total phosphoric acid, 6 to 8 per cent.; potassium oxide, 4 to 6 per cent.; ammonia, 3 to 5 per cent. (equivalent to nitrogen, 2.5 to 4 per cent.).

	Per cent.
Moisture at 100 C.,	10.60
Total phosphoric acid,	6.04
Soluble phosphoric acid,	.32
Reverted phosphoric acid,	2.45
Insoluble phosphoric of acid,	3.27
Potassium oxide,	4.34
Nitrogen,	2.76
Insoluble matter,	.65

Valuation per two thousand pounds: —

6. pounds of soluble phosphoric acid,	$0 70
49. pounds of reverted phosphoric acid,	3 92
65.4 pounds of insoluble phosphoric acid,	3 92
86.8 pounds of potassium oxide,	3 69
55.2 pounds of nitrogen,	12 70
	$24 93

Fish and Potash.

(Quinnipiac Fertilizer Co., New London, Ct.; collected of Wm. H. Earle, Worcester, Mass.)

Guaranteed composition: total phosphoric acid, 5 to 7 per cent.; soluble and reverted phosphoric acid (available), 3 to 5 per cent.; potassium oxide, 3 to 5 per cent.; nitrogen, 3.25 to 4.25 per cent.

	Per cent.
Moisture at 100° C.,	24.08
Total phosphoric acid,	5.93
Soluble phosphoric acid,	.93
Reverted phosphoric acid,	1.95
Insoluble phosphoric acid,	3.05
Potassium oxide,	3.91
Nitrogen,	4.27

Valuation per two thousand pounds: —

18.6 pounds of soluble phosphoric acid,	$2 05
39. pounds of reverted phosphoric acid,	3 12
61. pounds of insoluble phosphoric acid,	3 66
78.2 pounds of potassium oxide,	3 32
85.4 pounds of nitrogen,	19 64
	$31 79

Williams, Clark & Co.'s Fish and Potash.

(Collected of Slate and DeWolf, Greenfield, Mass.)

Guaranteed composition: total phosphoric acid, 3 to 4 per cent.; potassium oxide, 3 to 4 per cent.; ammonia, 4 to 5 per cent. (equivalent to nitrogen, 3.30 to 4.13 per cent.).

	Per cent.
Moisture at 100° C.,	10.98
Total phosphoric acid,	6.08
Soluble phosphoric acid,	.00
Reverted phosphoric acid,	2.75
Insoluble phosphoric acid,	3.33
Potassium oxide,	3.06
Nitrogen,	3.22

Valuation per two thousand pounds: —

55. pounds of reverted phosphoric acid,	$1 40
66.6 pounds of insoluble phosphoric acid,	4 00
61.2 pounds of potassium oxide,	2 60
64.4 pounds of nitrogen,	14 81
	$25 81

Bradley's Fish and Potash.

(Collected of Sheldon and Newcomb, Greenfield, Mass.)

Guaranteed composition: potassium oxide, 4 to 5 per cent.; ammonia, 4 to 5 per cent (equivalent to nitrogen 3.3 to 4.1 per cent.).

	Per cent.
Moisture at 100° C.,	16.92
Total phosphoric acid,	4.41
Soluble phosphoric acid,	.96
Reverted phosphoric acid,	1.45
Insoluble phosphoric acid,	2.00
Potassium oxide,	4.92
Nitrogen,	3.69

Valuation per two thousand pounds: —

19 2 pounds of soluble phosphoric acid,	$2 11
29.0 pounds of reverted phosphoric acid,	2 32
40. pounds of insoluble phosphoric acid,	2 40
98.4 pounds of potassium oxide,	4 18
73.8 pounds of nitrogen,	16 97
	$27 98

III. — Bone-Fertilizers.

Edward A. Smith's Crushed Raw Bone.

(Collected of J. A. Rice, Worcester, Mass.)

	Per cent.
Moisture at 100° C.,	8.28
Total phosphoric acid,	22.82
Nitrogen,	3.69
Insoluble matter,	.65

Valuation per two thousand pounds: —

456.4 pounds of insoluble phosphoric acid,	$27 38
73.8 pounds of nitrogen,	16 97
	$44 35

Fine Ground Bones.

(C. A. Bellknap and Son, Portland, Maine; collected of J. and J. A. Rice, Worcester, Mass.)

	Per cent.
Moisture at 100° C.,	7 66
Total phosphoric acid,	19.37
Reverted phosphoric acid,	7.01
Insoluble phosphoric acid,	12.36
Nitrogen,	2 96

Valuation per two thousand pounds: —

140.2 pounds of reverted phosphoric acid,	$11 22
247.2 pounds of insoluble phosphoric acid,	14 83
59.2 pounds of nitrogen,	13 62
	$39 67

Bradley's Fine Ground Bones.

(Collected of Breck and Son, Boston, Mass.)

	Per cent.
Moisture at 100° C.,	7.17
Total phosphoric acid,	23.28
Nitrogen,	3.95
Insoluble matter,	1.08

Valuation per two thousand pounds: —

465.6 pounds of insoluble phosphoric acid,	$27 94
79. pounds of nitrogen,	18 17
	$46 11

Darling's Fine Bones.

(Collected of Parker and Gannet, Boston, Mass.)

	Per cent.
Moisture at 100° C.,	7.10
Total phosphoric acid,	25.45
Nitrogen,	2 90
Insoluble matter,	.45

Valuation per two thousand pounds: —

509. pounds of insoluble phosphoric acid,	$30 54
58. pounds of nitrogen,	13 34
	$43 88

Ground Fine Bones.

(Bowker Fertilizer Co., Boston, Mass.)

	Per cent.
Moisture at 100° C.,	6.53
Total phosphoric acid,	23.82
Nitrogen,	3.83

Valuation per two thousand pounds: —

476.4 pounds of insoluble phosphoric acid,	$28 58
76.6 pounds of nitrogen,	17 62
	$16 20

Holyoke Fine Bones.

(Collected of D. A. Horton, Northampton, Mass.)

	Per cent.
Moisture at 100° C.,	9.50
Total phosphoric acid,	24.96
Nitrogen,	3.97
Insoluble matter,	.38

Valuation per two thousand pounds: —

499.2 pounds of insoluble phosphoric acid,	$29 95
79.4 pounds of nitrogen,	18 26
	$48 21

IV. — Complete Manures and Ammoniated Superphosphates.

Peruvian Guano.

(Collected of D. A. Horton, Northampton, Mass.)

Guaranteed composition: total phosphoric acid, 16 to 18

per cent.; potassium oxide, 3 to 6 per cent.; ammonia, 5 to 6 per cent (equivalent to nitrogen, 4.1 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	14.00
Total phosphoric acid,	20.60
Soluble phosphoric acid,	3.10
Reverted phosphoric acid,	1.55
Insoluble phosphoric acid,	15.95
Potassium oxide,	1 14
Nitrogen (inorganic matter),	1.40
Nitrogen (in ammonia salts),	3.04

Valuation per two thousand pounds: —

62. pounds of soluble phosphoric acid,	$6 82
31. pounds of reverted phosphoric acid,	2 48
319. pounds of insoluble phosphoric acid,	19 14
22.8 pounds of potassium oxide,	97
28. pounds of nitrogen (in organic matter),	6 44
60.8 pounds of nitrogen (in ammonia salts),	15 81
	$51 66

Mitchell's Standard Phosphate.

(Collected of J. and J. A. Rice, Worcester, Mass.)

Guaranteed composition: total phosphoric acid, 12.42 per cent.; soluble phosphoric acid, 9.85 per cent.; insoluble phosphoric acid, 2.57 per cent.; potassium oxide, 2.16 per cent.; nitrogen, 2.64 per cent.

	Per cent.
Moisture at 100° C.,	16.10
Total phosphoric acid,	11.56
Soluble phosphoric acid,	6.10
Reverted phosphoric acid,	.94
Insoluble phosphoric acid,	4.52
Potassium oxide,	4.24
Nitrogen,	2.23
Insoluble matter,	6.15

Valuation per two thousand pounds: —

122. pounds of soluble phosphoric acid,	$13 42
18.8 pounds of reverted phosphoric acid,	1 50
90.4 pounds of insoluble phosphoric acid,	5 42
84.8 pounds of potassium oxide,	3 60
44.6 pounds of nitrogen,	10 26
	$34 20

Russell Coe's Ammoniated Bone Superphosphate.

(Collected of Wm. H. Earle, Worcester, Mass.)

Guaranteed composition: total phosphoric acid, 12 to 15 per cent.; soluble and reverted phosphoric acid (available), 10 to 12 per cent.; potassium oxide, 2.5 to 4 per cent.; nitrogen, 1.75 to 2.5 per cent.

	Per cent.
Moisture at 100 C.,	16.52
Total phosphoric acid,	8.44
Soluble phosphoric acid,	4.22
Reverted phosphoric acid,	1.13
Insoluble phosphoric acid,	3.09
Potassium oxide,	1.40
Nitrogen,	2.95
Insoluble matter,	3.20

Valuation per two thousand pounds: —

84 4 pounds of soluble phosphoric acid,	$9 28
22.6 pounds of reverted phosphoric acid,	1 81
61.8 pounds of insoluble phosphoric acid,	3 71
28. pounds of potassium oxide,	1 19
59. pounds of nitrogen,	13 57
	$29 56

Stockbridge Manures, Grass Top Dressing.

(Collected of Breck and Son, Boston, Mass.)

Guaranteed composition: total phosphoric acid, 6 to 8 per cent.; soluble and reverted phosphoric acid (available), 5 to 6 per cent.; potassium oxide, 4 to 5 per cent.; nitrogen, 4.25 to 5 per cent., ammonia, 5 to 6 per cent.

	Per cent.
Moisture at 100° C.,	18.25
Total phosphoric acid,	8.32
Soluble phosphoric acid,	5.56
Reverted phosphoric acid,	.97
Insoluble phosphoric acid,	1.79
Potassium oxide,	5.65
Nitrogen (in organic matter),	4.16
Nitrogen (in nitrates),	1.90
Insoluble matter,	4.75

Valuation per two thousand pounds: —

111.2 pounds of soluble phosphoric acid,	$12 23
19.4 pounds of reverted phosphoric acid,	1 55
35.8 pounds of insoluble phosphoric acid,	2 15
113. pounds of potassium oxide,	4 80
83.2 pounds of nitrogen (in organic matter),	19 14
38. pounds of nitrogen (in nitrates),	7 60
	$47 47

Sparrow's Grass Fertilizer.

(Judson and Sparrow; collected of Everett and Gleason, Boston, Mass.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 8 to 9 per cent.; potassium oxide, 4 to 5 per cent.; ammonia, 5 to 6 per cent. (equivalent to nitrogen, 4.1 to 4.9 per cent.).

	Per cent.
Moisture at 100° C.,	10.40
Total phosphoric acid,	9.60
Soluble phosphoric acid,	7.45
Reverted phosphoric acid,	1.09
Insoluble phosphoric acid,	1.06
Potassium oxide,	4.28
Nitrogen,	4.73
Insoluble matter,	.70

Valuation per two thousand pounds: —

149. pounds of soluble phosphoric acid,	$16 39
21.8 pounds of reverted phosphoric acid,	1 74
21.2 pounds of insoluble phosphoric acid,	1 27
85.6 pounds of potassium oxide,	3 64
94.6 pounds of nitrogen,	21 76
	$44 80

Standard Superphosphate.

(Standard Fertilizer Co., Boston; collected of Whittemore Bros., Boston.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 9 to 13 per cent.; insoluble phosphoric acid, 2 to 4 per cent.; magnesium oxide, 1.5 to 2 per cent.; potassium oxide, 2 to 4 per cent.; ammonia, 2 to 4 per cent. (equivalent to nitrogen, 1.6 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	18 35
Total phosphoric acid,	10.22

	Per cent.
Soluble phosphoric acid,	7.13
Reverted phosphoric acid,	.98
Insoluble phosphoric acid,	2.11
Potassium oxide,	1.30
Nitrogen,	2.20
Magnesium oxide,	1.30
Insoluble matter,	6.35

Valuation per two thousand pounds: —

142.6 pounds of soluble phosphoric acid,	$15 69
19.6 pounds of reverted phosphoric acid,	1 57
42.2 pounds of insoluble phosphoric acid,	2 53
26. pounds of potassium oxide,	1 11
44. pounds of nitrogen,	10 12
	$31 02

Darling's Animal Fertilizer.

(Collected of Parker and Gannet, Boston, Mass.)

Guaranteed composition: total phosphoric acid, 10 to 12 per cent.; potassium oxide, 5 to 6 per cent.; nitrogen, 4 to 6 per cent.

	Per cent.
Moisture at 100° C.,	12.44
Total phosphoric acid,	12.94
Soluble phosphoric acid,	.13
Reverted phosphoric acid,	4.70
Insoluble phosphoric acid,	8.11
Potassium oxide,	3.03
Nitrogen,	3.59
Insoluble matter,	2.12

Valuation per two thousand pounds: —

2.6 pounds of soluble phosphoric acid,	$0 29
94. pounds of reverted phosphoric acid,	7 52
162.2 pounds of insoluble phosphoric acid,	9 73
60.6 pounds of potassium oxide,	2 58
71.8 pounds of nitrogen,	16 51
	$36 63

Sparrow's Bone and Potash Phosphate.

(Judson and Sparrow; collected of Everett and Gleason, Boston, Mass.)

Guaranteed composition: soluble phosphoric acid, 9 to 11 per cent.; potassium oxide, 4 to 5 per cent.; ammonia,

3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	14.75
Total phosphoric acid,	12.06
Soluble phosphoric acid,	11.60
Reverted phosphoric acid,	.22
Insoluble phosphoric acid,	.24
Potassium oxide,	3 89
Nitrogen,	3.39
Insoluble matter,	.65

Valuation per two thousand pounds: —

232. pounds of soluble phosphoric acid,	$25 52
4.4 pounds of reverted phosphoric acid,	35
4.8 pounds of insoluble phosphoric acid,	29
77.8 pounds of potassium oxide,	3 31
67.8 pounds of nitrogen,	15 59
	$45 06

Darling's Lawn Dresser.

(Collected of Parker and Gannet, Boston, Mass.)

Guaranteed composition: total phosphoric acid, 10 to 13 per cent.; potassium oxide, 5 to 6 per cent.; ammonia, 5 to 7 per cent. (equivalent to nitrogen, 4.1 to 5.7 per cent.).

	Per cent.
Moisture at 100° C.,	9 43
Total phosphoric acid,	10.83
Soluble phosphoric acid,	.58
Reverted phosphoric acid,	2.40
Insoluble phosphoric acid,	7.85
Potassium oxide,	6.14
Nitrogen,	4.47
Insoluble matter,	1.18

Valuation per two thousand pounds: —

11.6 pounds of soluble phosphoric acid,	$1 28
48. pounds of reverted phosphoric acid,	3 84
157. pounds of insoluble phosphoric acid,	9 42
122.8 pounds of potassium oxide,	5 22
89.4 pounds of nitrogen,	20 56
	$40 32

Bradley's Complete Manure, Potato and Roots.

(Collected of Breck and Son, Boston, Mass.)

Guaranteed composition: soluble phosphoric acid, 8 to 10 per cent.; potassium oxide, 4.5 to 5.5 per cent.; ammonia, 4 to 5 per cent. (equivalent to nitrogen, 3.3 to 4.1 per cent.).

	Per cent.
Moisture at 100° C.,	10.15
Total phosphoric acid,	12.19
Soluble phosphoric acid,	4.80
Reverted phosphoric acid,	3.19
Insoluble phosphoric acid,	4.20
Potassium oxide,	4.48
Nitrogen,	3.78
Insoluble matter,	3.88

Valuation per two thousand pounds: —

96. pounds of soluble phosphoric acid,	$10 56
63.8 pounds of reverted phosphoric acid,	5 10
84. pounds of insoluble phosphoric acid,	5 04
89.6 pounds of potassium oxide,	3 81
75.6 pounds of nitrogen,	17 39
	$41 90

Bradley's Complete Manure, Corn and Grain.

(Collected of Breck and Son, Boston, Mass.)

Guaranteed composition: soluble phosphoric acid, 6 to 8 per cent.; potassium oxide, 4 to 5 per cent; ammonia, 4 to 5 per cent. (equivalent to nitrogen, 3.3 to 4.1 per cent.).

	Per cent.
Moisture at 100° C.,	8.60
Total phosphoric acid,	10.65
Soluble phosphoric acid,	6.37
Reverted phosphoric acid,	.88
Insoluble phosphoric acid,	3.40
Potassium oxide,	6.45
Nitrogen,	4.51
Insoluble matter,	4.51

Valuation per two thousand pounds: —

127.4 pounds of soluble phosphoric acid,	$14 01
17.6 pounds of reverted phosphoric acid,	1 41
68. pounds of insoluble phosphoric acid,	4 08
129. pounds of potassium oxide,	5 48
90.2 pounds of nitrogen,	20 75
	$45 73

Standard Lawn Dressing.

(Standard Fertilizer Co.; collected of Whittemore Bros., Boston, Mass.)

No guarantee obtained.

	Per cent.
Moisture at 100° C.,	16.00
Total phosphoric acid,	13.60
Soluble phosphoric acid,	9.88
Reverted phosphoric acid,	.06
Insoluble phosphoric acid,	3.66
Potassium oxide,	2.66
Nitrogen,	2.34
Insoluble matter,	.93

Valuation per two thousand pounds:

197.6 pounds of soluble phosphoric acid,	$21 74
1.2 pounds of reverted phosphoric acid,	10
73.2 pounds of insoluble phosphoric acid,	4 39
53.2 pounds of potassium oxide,	2 26
46.8 pounds of nitrogen,	10 76
	$39 25

Bay State Ammoniated Bone Superphosphate.

(J. A. Tucker & Co., Boston, Mass.; collected by H. A. Emerson, Winchester, Mass.)

Guaranteed composition: total phosphoric acid, 12.20 per cent.; soluble and reverted phosphoric acid (available), 9.20 per cent.; insoluble phosphoric acid, 3.00 per cent.; ammonia, 3.29 per cent. (equivalent to nitrogen, 2.71 per cent.).

	Per cent.
Moisture at 100° C.,	27.67
Total phosphoric acid,	9.58
Soluble phosphoric acid,	7.34
Reverted phosphoric acid,	.66
Insoluble phosphoric acid,	1.58
Potassium oxide,	.75
Nitrogen,	3.20

Valuation per two thousand pounds: —

146.8 pounds of soluble phosphoric acid,	$16 15
13.2 pounds of reverted phosphoric acid,	1 06
31.6 pounds of insoluble phosphoric acid,	1 90
15. pounds of potassium oxide,	64
64. pounds of nitrogen,	14 72
	$34 47

Bowker's Lawn Dressing.

(Collected by E. A. Thompson, Woburn, Mass.)

Guaranteed composition: total phosphoric acid, 6 to 8 per cent.; soluble and reverted phosphoric acid (available), 5 to 6 per cent.; potassium oxide, 4 to 5 per cent; nitrogen, 4 to 5 per cent. (equivalent to ammonia, 4.5 to 5.5 per cent.).

	Per cent.
Moisture at 100° C.,	5.33
Total phosphoric acid,	9.92
Soluble phosphoric acid,	5.73
Reverted phosphoric acid,	1.93
Insoluble phosphoric acid,	2.26
Potassium oxide,	5.52
Nitrogen (in organic matter),	1.19
Nitrogen (in ammonia salts),	3.28
Insoluble matter,	5.65

Valuation per two thousand pounds: —

114.6 pounds of soluble phosphoric acid,	$12 61
38.6 pounds of reverted phosphoric acid,	3 09
45.2 pounds of insoluble phosphoric acid,	2 71
110.4 pounds of potassium oxide,	4 69
23 8 pounds of nitrogen (in organic matter),	5 47
65.6 pounds of nitrogen (in ammonia salts),	17 06
	$45 63

Bay State Bone Superphosphate.

(J. J. Tucker, Boston, Mass.; collected of G. B. Knowlton, Fitchburg, Mass.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 9 to 10.5 per cent.; insoluble phosphoric acid, 1.5 to 3 per cent.; ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	22.45
Total phosphoric acid,	10.95
Soluble phosphoric acid,	8.80
Reverted phosphoric acid,	.71
Insoluble phosphoric acid,	1.44
Nitrogen,	3.12
Insoluble matter,	4.25

Valuation per two thousand pounds: —

176.0 pounds of soluble phosphoric acid,	$19 36
14.2 pounds of reverted phosphoric acid,	1 14
28.8 pounds of insoluble phosphoric acid,	1 73
62.4 pounds of nitrogen,	14 35
	$36 58

Standard Superphosphate.

(Standard Fertilizer Co., Boston, Mass.; collected of E. N. Wood, Lowell, Mass.)

Guaranteed composition: total phosphoric acid, 9 to 14 per cent.; potassium oxide, 1 to 3 per cent.; ammonia, 2 to 4 per cent. (equivalent to nitrogen, 1.6 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	20.75
Total phosphoric acid,	11.55
Soluble phosphoric acid,	8.13
Reverted phosphoric acid,	2.51
Insoluble phosphoric acid,	.91
Potassium oxide,	1.35
Nitrogen,	2.17
Insoluble matter,	4.55

Valuation per two thousand pounds: —

162.6 pounds of soluble phosphoric acid,	$17 89
50.2 pounds of reverted phosphoric acid,	4 02
18.2 pounds of insoluble phosphoric acid,	1 09
27. pounds of potassium oxide,	1 15
43.4 pounds of nitrogen,	9 98
	$34 13

Stockbridge Manures, Pease and Beans.

(Bowker Fertilizer Co., Boston, Mass.; collected of E. N. Wood, Lowell. Mass.)

Guaranteed composition: soluble phosphoric acid, 8 to 10 per cent.; potassium oxide, 2 to 3 per cent.; ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	17.10
Total phosphoric acid,	9.62
Soluble phosphoric acid,	6.08
Reverted phosphoric acid,	.84
Insoluble phosphoric acid,	2.70
Potassium oxide,	4.13
Nitrogen (in organic matter),	1.60
Nitrogen (in ammonia salts),	.23
Nitrogen (in nitrates),	.74
Insoluble matter,	2.70

Valuation per two thousand pounds: —

121.6 pounds of soluble phosphoric acid,	$13 38
16.8 pounds of reverted phosphoric acid,	1 34
54. pounds of insoluble phosphoric acid,	3 24
82.6 pounds of potassium oxide,	3 51
32. pounds of nitrogen (in organic matter),	7 36
4.6 pounds of nitrogen (in ammonia salts),	92
14.8 pounds of nitrogen (in nitrates),	3 85
	$33 60

Bone Superphosphate.

(Lowell Bone Fertilizer Co.; collected of R. C. Lord, Lowell, Mass.)

Guaranteed composition: moisture, 5.9 per cent.; soluble phosphoric acid, 14.68 per cent.; reverted phosphoric acid, .32 per cent.; insoluble phosphoric acid, .86 per cent.; nitrogen, 3.37 per cent.

	Per cent.
Moisture at 100° C.,	10.45
otal phosphoric acid,	16.03
Soluble phosphoric acid,	11.69
Reverted phosphoric acid,	3.97
Insoluble phosphoric acid,	.37
Nitrogen,	2.82

Valuation per two thousand pounds: —

233.8 pounds of soluble phosphoric acid,	$25 72
79.4 pounds of reverted phosphoric acid,	6 35
7.4 pounds of insoluble phosphoric acid,	44
6.4 pounds of nitrogen,	12 97
	$45 48

Bradley's XL Ammoniated Bone Superphosphate.

(Collected of Garfield and Proctor, Fitchburg, Mass.)

Guaranteed composition: soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 3 per cent.; nitrogen, 2.5 to 3.25 per cent.

	Per cent.
Moisture at 100° C.,	15.97
Total phosphoric acid,	10.80
Soluble phosphoric acid,	7.34
Reverted phosphoric acid,	.39
Insoluble phosphoric acid,	3.07

	Per cent.
Potassium oxide,	3.44
Nitrogen,	2.44
Insoluble matter,	5.60

Valuation per two thousand pounds : —

146.8 pounds of soluble phosphoric acid,	$16 15
7.8 pounds of reverted phosphoric acid,	62
61.4 pounds of insoluble phosphoric acid,	3 68
68.8 pounds of potassium oxide,	2 92
48.8 pounds of nitrogen,	11 22
	$34 59

Standard Superphosphate.

(Standard Fertilizer Co., Boston, Mass.; collected of A. B. Lawrence, Fitchburg, Mass.)

Guaranteed composition : total phosphoric acid, 9 to 14 per cent. ; potassium oxide, 1 to 3 per cent. ; ammonia, 2 to 4 per cent. (equivalent to nitrogen, 1.6 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	18.08
Total phosphoric acid,	13.32
Soluble phosphoric acid,	7.07
Reverted phosphoric acid,	3.80
Insoluble phosphoric acid,	2.46
Potassium oxide,	1.43
Nitrogen (in organic matter),	1.11
Nitrogen (in nitrates),	1.49

Valuation per two thousand pounds : —

141.4 pounds of soluble phosphoric acid,	$15 55
76. pounds of reverted phosphoric acid,	6 08
49 2 pounds of insoluble phosphoric acid,	2 95
28.6 pounds of potassium oxide,	1 22
22 2 pounds of nitrogen (in organic matter,)	5 11
29.8 pounds of nitrogen (in nitrates),	5 96
	$36 87

Bowker's Grass Top Dressing, Forage Crops.

(Collected of J. C. Wright, Fitchburg, Mass.)

Guaranteed composition : total phosphoric acid, 6 to 8 per cent. ; soluble and reverted phosphoric acid (available), 5

to 6 per cent.; nitrogen, 4.25 to 5 per cent., or ammonia, 5 to 6 per cent.; potassium oxide, 4 to 5 per cent.

	Per cent.
Moisture at 100° C.,	10.38
Total phosphoric acid,	8.75
Soluble phosphoric acid,	3.61
Reverted phosphoric acid,	1.29
Insoluble phosphoric acid,	3.85
Potassium oxide,	5.64
Nitrogen (in organic matter),	2.30
Nitrogen (in ammonia salts),	.44
Nitrogen (in nitrates),	.93

Valuation per two thousand pounds: —

72.2 pounds of soluble phosphoric acid,	$7 94
25.8 pounds of reverted phosphoric acid,	2 06
77. pounds of insoluble phosphoric acid,	4 62
112.8 pounds of potassium oxide,	4 79
46. pounds of nitrogen (in organic matter),	10 58
8.8 pounds of nitrogen (in ammonia salts),	2 29
18.6 pounds of nitrogen (in nitrates),	3 72
	$36 00

Baugh's Double Eagle Phosphate.

(Sent on by John E. Russell, Secretary of State Board of Agriculture.)

Guaranteed composition: soluble and reverted (available), 5 to 6 per cent.; insoluble phosphoric acid, 3.21 to 3.66 per cent.; ammonia, 2 to 2.5 per cent.

	Per cent.
Moisture at 100° C.,	7.23
Total phosphoric acid,	8.86
Soluble phosphoric acid,	4.49
Reverted phosphoric acid,	1.19
Insoluble phosphoric acid,	3.19
Nitrogen,	2.20

Valuation per two thousand pounds: —

89.8 pounds of soluble phosphoric acid,	$9 88
23.8 pounds of reverted phosphoric acid,	1 90
63.8 pounds of insoluble phosphoric acid,	3 83
44. pounds of nitrogen,	10 12
	$25 73

The Economical Fertilizer.

(Baugh and Sons, Philadelphia, Penn.; sent on by John E. Russell, Secretary of Massachusetts State Board of Agriculture.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 5 to 6 per cent.; potassium oxide (sulphate), 4 to 5 per cent.; ammonia, 2 to 2.5 per cent.

	Per cent.
Moisture at 100° C.,	8.10
Total phosphoric acid,	8.68
Soluble phosphoric acid,	3.13
Reverted phosphoric acid,	.33
Insoluble phosphoric acid,	4.67
Potassium oxide,	2.31
Nitrogen,	2.74

Valuation per two thousand pounds: —

62.6 pounds of soluble phosphoric acid,	$6 89
6.6 pounds of reverted phosphoric acid,	53
93.4 pounds of insoluble phosphoric acid,	5 60
46.2 pounds of potassium oxide,	3 23
54.8 pounds of nitrogen,	12 61
	$28 86

Dole's Common-Sense Fertilizer. D

(Collected of Parker and Gannet, Springfield, Mass.)

Guaranteed composition: total phosphoric acid, 1 to 3 per cent.; potassium oxide, 1 to 3 per cent.; nitrogen, 2 to 4 per cent.

	Per cent.
Moisture at 100° C.,	9.72
Total phosphoric acid,	1.47
Soluble phosphoric acid,	.12
Reverted phosphoric acid,	.96
Insoluble phosphoric acid,	.39
Potassium oxide,	1.11
Nitrogen,	1.35
Insoluble matter,	47.12

Valuation per two thousand pounds: —

2.4 pounds of soluble phosphoric acid,	$0 26
19.2 pounds of reverted phosphoric acid,	1 54
7.8 pounds of insoluble phosphoric acid,	47
22.2 pounds of potassium oxide,	94
27. nitrogen,	6 21
	$9 42

Chittenden's Complete Manure, Grain.

(Collected of G. P. Smith, Sunderland, Mass.)

Guaranteed composition: total phosphoric acid, 8 to 10 per cent.; soluble and reverted phosphoric acid (available), 6 to 8 per cent.; potassium oxide, 5 to 7 per cent.; ammonia, 4.5 to 5.5 per cent. (equivalent to nitrogen, 3.7 to 4.5 per cent.).

	Per cent.
Moisture at 100° C.,	12.90
Total phosphoric acid,	8.81
Soluble phosphoric acid,	6.52
Reverted phosphoric acid,	2.00
Insoluble phosphoric acid,	.29
Potassium oxide,	5.28
Nitrogen (in organic matter),	2.79
Nitrogen (in nitrates),	.38
Insoluble matter,	4.70

Valuation per two thousand pounds: —

130.4 pounds of soluble phosphoric acid,	$14 34
40. pounds of reverted phosphoric acid,	3 20
5.8 pounds of insoluble phosphoric acid,	35
105.6 pounds of potassium oxide,	4 49
55.8 pounds of nitrogen (in organic matter),	12 83
7.6 pounds of nitrogen (in nitrates),	1 52
	$36 73

L. L. Crocker's Potato and Hop Phosphate.

(Collected of Slate and DeWolf, Greenfield, Mass.)

Guaranteed composition: soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 2 to 4 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium oxide, 6 to 8 per cent.; ammonia, 2.5 to 3.5 per cent. (equivalent to nitrogen, 2.1 to 3 per cent.).

	Per cent.
Moisture at 100° C.,	17.15
Total phosphoric acid,	10.46
Soluble phosphoric acid,	6.39
Reverted phosphoric acid,	.20
Insoluble phosphoric acid,	3.87
Potassium oxide,	4.52
Nitrogen,	2.65
Insoluble matter,	4.07

Valuation per two thousand pounds: —

127.8 pounds of soluble phosphoric acid,	$14 06
4.0 pounds of reverted phosphoric acid,	32
77.4 pounds of insoluble phosphoric acid,	4 64
90.4 pounds of potassium oxide,	3 84
53. pounds of nitrogen,	12 19
	$35 05

Bradley's Sea Fowl.

(Collected of Sheldon and Newcomb, Greenfield, Mass.)

Guaranteed composition: soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 3 per cent.; nitrogen, 2.5 to 3-25 per cent.

	Per cent.
Moisture at 100° C.,	12.37
Total phosphoric acid,	11.87
Soluble phosphoric acid,	7.77
Reverted phosphoric acid,	1.87
Insoluble phosphoric acid,	2.23
Potassium oxide,	3.22
Nitrogen,	2.79

Valuation per two thousand pounds: —

155.4 pounds of soluble phosphoric acid,	$17 09
37.4 pounds of reverted phosphoric acid,	2 99
44.6 pounds of insoluble phosphoric acid,	2 68
64.4 pounds of potassium oxide,	2 74
55.8 pounds of nitrogen,	12 83
	$38 33

Chittenden's Root Fertilizer.

(Collected of G. P. Smith, Sunderland, Mass.)

Guaranteed composition: total phosphoric acid, 8 to 10 per cent.; soluble and reverted phosphoric acid (available), 6 to 8 per cent.; potassium oxide, 6 to 8 per cent.; ammonia, 4 to 5 per cent. (equivalent to nitrogen, 3.32 to 4.15 per cent.).

	Per cent.
Moisture at 100° C.,	12.38
Total phosphoric acid,	8.57

	Per cent.
Soluble phosphoric acid,	5.34
Reverted phosphoric acid,	1 91
Insoluble phosphoric acid,	1.32
Potassium oxide,	6.68
Nitrogen (in organic matter),	2.45
Nitrogen (in nitrates),	.58

Valuation per two thousand pounds: —

106.8 pounds of soluble phosphoric acid,	$11 75
38.2 pounds of reverted phosphoric acid,	3 06
26.4 pounds of insoluble phosphoric acid,	1 58
133.6 pounds of potassium oxide,	5 68
49. pounds of nitrogen (in organic matter),	11 27
11.6 pounds of nitrogen (in nitrates),	2 32
	$35 66

Standard Superphosphate.

(Standard Fertilizer Co., Boston, Mass.; collected of Wm. H. Earle, Worcester, Mass.)

Guaranteed composition: total phosphoric acid, 13 to 15 per cent.; soluble and reverted phosphoric acid (available), 9 to 13 per cent.; insoluble phosphoric acid, 2 to 4 per cent.; potassium oxide, 2 to 4 per cent.; magnesium oxide, 1.5 to 2 per cent.; ammonia, 2 to 4 per cent. (equivalent to nitrogen, 1.6 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	19.38
Total phosphoric acid,	12.14
Soluble phosphoric acid,	7.29
Reverted phosphoric acid,	2.09
Insoluble phosphoric acid,	2.76
Potassium oxide,	1.51
Nitrogen,	1.81

Valuation per two thousand pounds: —

145.8 pounds of soluble phosphoric acid,	$16 04
41.8 pounds of reverted phosphoric acid,	3 34
55.2 pounds of insoluble phosphoric acid,	3 31
30.2 pounds of potassium oxide,	1 28
36.2 pounds of nitrogen,	8 33
	$32 30

Soluble Pacific Guano.

(Pacific Guano Co., Boston, Mass.; collected of J. S. Clark and Son, Worcester, Mass.)

Guaranteed composition: soluble phosphoric acid, 6.5 to 8 per cent.; reverted phosphoric acid, 1.6 to 3 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 3.5 per cent.; nitrogen, 2 to 3 per cent.

	Per cent.
Moisture at 100° C.,	8.35
Total phosphoric acid,	13.07
Soluble phosphoric acid,	6.87
Reverted phosphoric acid,	1.17
Insoluble phosphoric acid,	5.03
Potassium oxide,	1.60
Nitrogen (in organic matter),	1.70
Nitrogen (in nitrates),	.17

Valuation per two thousand pounds: —

137.4 pounds of soluble phosphoric acid,	$15 11
23.4 pounds of reverted phosphoric acid,	1 87
100.6 pounds of insoluble phosphoric acid,	6 04
32. pounds of potassium oxide,	1 36
34. pounds of nitrogen (in organic matter),	7 82
3.4 pounds of nitrogen (in nitrates),	68
	$32 88

Quinnipiac Co.'s Phosphate.

(Collected of Wm. H. Earle, Worcester, Mass.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 8 to 10 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium oxide, 2 to 3 per cent.; nitrogen, 2.5 to 3.5 per cent.

	Per cent.
Moisture at 100° C.,	19.10
Total phosphoric acid,	11.03
Soluble phosphoric acid,	7.96
Reverted phosphoric acid,	1.45
Insoluble phosphoric acid,	1 62
Potassium oxide,	2.04
Nitrogen (in organic matter),	2.08
Nitrogen (in nitrates),	79

Valuation per two thousand pounds: —

159.2 pounds of soluble phosphoric acid,	$17 51
29. pounds of reverted phosphoric acid,	2 32
32.4 pounds of insoluble phosphoric acid,	1 94
40.8 pounds of potassium oxide,	1 73
41.6 pounds of nitrogen (in organic matter),	9 57
15.8 pounds of nitrogen (in nitrates),	3 16
	$36 23

Williams, Clark and Co., "Americus" Ammoniated Bone Superphosphate.

(Collected of Wilson and Holden, Worcester, Mass.]

Guaranteed composition: soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 3 to 4 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium oxide, 1 to 2 per cent.; ammonia, 2 to 3 per cent. (equivalent to nitrogen, 1.7 to 2.5 per cent.).

	Per cent.
Moisture at 100° C.,	16.75
Total phosphoric acid,	11.29
Soluble phosphoric acid,	6.68
Reverted phosphoric acid,	1.05
Insoluble phosphoric acid,	3.56
Potassium oxide,	2.12
Nitrogen,	2.38
Insoluble matter,	7.45

Valuation per two thousand pounds: —

133.6 pounds of soluble phosphoric acid,	$14 70
21. pounds of reverted phosphoric acid,	1 68
71.2 pounds of insoluble phosphoric acid,	4 27
42.4 pounds of potassium oxide,	1 80
47.6 pounds of nitrogen,	10 95
	$33 40

L. L. Crocker's Bone Superphosphate.

(Collected of C. W. Sears, Worcester, Mass.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 8 to 12 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium oxide, 1 to 3 per cent.; ammonia, 3.5 to 4.5 per cent. (equivalent to nitrogen, 2.9 to 3.7 per cent.).

	Per cent.
Moisture at 100° C.,	17.10
Total phosphoric acid,	9 95
Soluble phosphoric acid,	7.26
Reverted phosphoric acid,	1.67
Insoluble phosphoric acid,	1.02
Potassium oxide,	4.00
Nitrogen,	2.13
Insoluble matter,	4.00

Valuation per two thousand pounds: —

145.2 pounds of soluble phosphoric acid,	$15 97
33.4 pounds of reverted phosphoric acid.	2 67
20 4 pounds of insoluble phosphoric acid,	1 22
80. pounds of potassium oxide,	3 40
42.6 pounds of nitrogen,	9 80
	$33 06

Stearns' Ammoniated Bone Superphosphate.

(Of Stearns & Co., New York; collected of Wilson & Holden, Worcester, Mass., by State Inspector.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 8 to 10 per cent.; potassium oxide, 2 to 3 per cent.; ammonia, 3 to 4 per cent (equivalent to nitrogen, 2.47 to 3.30 per cent.). The manufacturers claim that the article tested represents another brand of his, which by mistake has been sent on.

	Per cent.
Moisture at 100° C.,	14.48
Total phosphoric acid,	10.30
Soluble phosphoric acid,	3.04
Reverted phosphoric acid,	6.12
Insoluble phosphoric acid,	1.14
Potassium oxide,	2.15
Nitrogen,	1.99

Valuation per two thousand pounds: —

60.80 pounds of soluble phosphoric acid,	$6 69
122.40 pounds of reverted phosphoric acid,	9 79
22.80 pounds of insoluble phosphoric acid,	1 37
43.00 pounds of potassium oxide,	1 83
39.80 pounds of nitrogen,	9 15
	$28 83

E. Frank Coe's Bone Superphosphate of Lime.

(Enoch Coe, Hunters Point, N. Y.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 11.96 per cent.; insoluble phosphoric acid, 1.28 per cent.; nitrogen, 2.64 per cent.

	Per cent.
Moisture at 100° C.,	22.90
Total phosphoric acid,	9.97
Soluble phosphoric acid,	7.84
Reverted phosphoric acid,	.43
Insoluble phosphoric acid,	1.70
Nitrogen,	2.54

Valuation per two thousand pounds: —

156.8 pounds of soluble phosphoric acid,	$17 25
8.6 pounds of reverted phosphoric acid,	69
34. pounds of insoluble phosphoric acid,	2 04
50.8 pounds of nitrogen,	11 68
	$31 66

Bosworth Bros' Superphosphate of Lime,

(Collected of Wilson & Holden, Worcester, Mass.)

Guaranteed composition: soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 4 to 5 per cent.; insoluble phosphoric acid, 2 to 5 per cent.; potassium oxide, 2 to 3 per cent.; nitrogen, 2 to 2.5 per cent.

	Per cent.
Moisture at 100° C.,	8.26
Total phosphoric acid,	16.60
Soluble phosphoric acid,	3.60
Reverted phosphoric acid,	5.10
Insoluble phosphoric acid,	7.90
Potassium oxide,	2.06
Nitrogen,	2.13
Insoluble matter,	.50

Valuation per two thousand pounds: —

72. pounds of soluble phosphoric acid,	$7 92
90.8 pounds of reverted phosphoric acid,	7 26
158. pounds of insoluble phosphoric acid,	9 48
41.2 pounds of potassium oxide,	1 75
42.6 pounds of nitrogen,	9 80
	$36 21

Bowker's Hill and Drill Phosphate.

(Collected of J. and J. A. Rice, Worcester, Mass.)

Guaranteed composition: soluble phosphoric acid, 8 to 10 per cent.; potassium oxide, 2 to 3 per cent.; ammonia, 2 to 3 per cent. (equivalent to nitrogen, 1.6 to 2.5 per cent.).

	Per cent.
Moisture at 100° C.,	$16.95
Total phosphoric acid,	8.91
Soluble phosphoric acid,	7.39
Reverted phosphoric acid,	1.05
Insoluble phosphoric acid,	.47
Potassium oxide,	1.29
Nitrogen,	2 32
Insoluble matter,	4 12

Valuation per two thousand pounds: —

147.8 pounds of soluble phosphoric acid,	$16 26
21. pounds of reverted phosphoric acid,	1 68
9.4 pounds of insoluble phosphoric acid,	56
25.8 pounds of potassium oxide,	1 10
46.4 pounds of nitrogen,	10 67
	$30 27

Bay State Ammoniated Bone Superphosphate.

(Collected of J. S. Clark & Son, Worcester, Mass.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 9 to 10 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; ammonia, 3.5 to 4. per cent. (equivalent to nitrogen, 2.9 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	26.78
Total phosphoric acid,	10.10
Soluble phosphoric acid,	7.33
Reverted phosphoric acid,	1.25
Insoluble phosphoric acid,	1.52
Nitrogen,	3.30

Valuation per two thousand pounds: —

146.6 pounds of soluble phosphoric acid,	$16 13
25. pounds of reverted phosphoric acid,	2 00
30.4 pounds of insoluble phosphoric acid,	1 82
66. pounds of nitrogen,	15 18
	$35 13

Stockbridge Manures, Grain.

(Collected of J. and J. A. Rice, Worcester, Mass.)

Guaranteed composition: total phosphoric acid, 7 to 9 per cent.; soluble and reverted phosphoric acid (available), 6 to 7 per cent.; potassium oxide, 4 to 5 per cent.; nitrogen, 3.25 to 4.25 per cent.

	Per cent.
Moisture at 100° C.,	14.53
Total phosphoric acid,	8.75
Soluble phosphoric acid,	2.91
Reverted phosphoric acid,	2.14
Insoluble phosphoric acid,	3.70
Potassium oxide,	5.33
Nitrogen (in organic matter),	3.57
Nitrogen (in nitrates),	1.27
Insoluble matter,	4.80

Valuation per two thousand pounds: —

58.2 pounds of soluble phosphoric acid,	$6 40
42.8 pounds of reverted phosphoric acid,	3 42
74. pounds of insoluble phosphoric acid,	4 44
106.6 pounds of potassium oxide,	4 53
71.4 pounds of nitrogen (in organic matter),	16 42
25.4 pounds of nitrogen (in nitrates),	5 08
	$40 29

Bradley's XL Ammoniated Bone Superphosphate.

(Collected of J. and J. A. Rice, Worcester, Mass.)

Guaranteed composition: soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 3 per cent.; nitrogen, 2.5 to 3.5 per cent.

	Per cent.
Moisture at 100° C.,	17.50
Total phosphoric acid,	12.40
Soluble phosphoric acid,	6.81
Reverted phosphoric acid,	3.04
Insoluble phosphoric acid,	2.55
Potassium oxide,	1.92
Nitrogen,	2.65
Insoluble matter,	4.23

Valuation per two thousand pounds: —

136.2 pounds af soluble phosphoric acid,	$14 98
60.8 pounds of reverted phosphoric acid,	4 86
51. pounds of insoluble phosphoric acid,	3 06
38.4 pounds of potassium oxide,	1 63
53. pounds of nitrogen,	12 19
	$36 72

Chittenden's Complete Manure, Grain.

(National Fertilizer Co., Bridgeport, Ct.; collected of J. A. Sullivan, Northampton, Mass.)

Guranteed composition: total phosphoric acid, 8 to 10 per cent.; soluble and reverted phosphoric acid (available), 6 to 8 per cent.; potassium oxide, 5 to 7 per cent.; ammonia, 4.5 to 5.5 per cent. (equivalent to nitrogen, 3.7 to 4.5 per cent.)

	Per cent.
Moisture at 100° C.,	14.17
Total phosphoric acid,	8.38
Soluble phosphoric acid,	5.14
Reverted phosphoric acid,	1.50
Insoluble phosphoric acid,	1.74
Potassium oxide,	5 38
Nitrogen (in organic matter),	3.04
Nitrogen (in nitrates),	.14
Insoluble matter,	4 10

Valuation per two thousand pounds: —

102.8 pounds of soluble phosphoric acid,	$11 31
30. pounds of reverted phosphoric acid.	2 40
34.8 pounds of insoluble phosphoric acid,	2 09
107.6 pounds of potassium oxide,	4 57
60.8 pounds of nitrogen (in organic matter),	13 98
2.8 pounds of nitrogen (in nitrates),	56
	$34 91

Dole's Common-Sense Fertilizer, No. Three.

(Collected of J. A. Sullivan, Northampton, Mass.)

Guaranteed composition: total phosphoric acid, 4 to 6 per cent.; potassium oxide, 3 to 5 per cent.; nitrogen, 3 to 6 per cent.

	Per cent.
Moisture at 100° C.,	14.20
Total phosphoric acid,	5.98
Soluble phosphoric acid,	.57
Reverted phosphoric acid,	2.35
Insoluble phosphoric acid,	3.06
Potassium oxide,	3.33
Nitrogen,	1.49
Insoluble matter.	31.90

Valuation per two thousand pounds: —

11.4 pounds of soluble phosphoric acid,	$1 25
47. pounds of reverted phosphoric acid,	3 76
61.2 pounds of insoluble phosphoric acid,	3 67
66.6 pounds of potassium oxide,	2 83
29.8 pounds of nitrogen,	6 85
	$18 36

L. L. Crocker's Ammoniated Bone Superphosphate.

(Collected of Fuller and Newton, Springfield, Mass.)

Guaranteed composition: soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 3 to 4 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium oxide, 1 to 3 per cent.; ammonia, 3.5 to 4.5 per cent. (equivalent to nitrogen, 2.9 to 3.7 per cent.)

	Per cent.
Moisture at 100° C.,	12.00
Total phosphoric acid,	12.90
Soluble phosphoric acid,	5.67
Reverted phosphoric acid,	2.61
Insoluble phosphoric acid,	4.62
Potassium oxide,	1.20
Nitrogen,	3 24
Insoluble matter,	2.70

Valuation per two thousand pounds: —

113.4 pounds of soluble phosphoric acid,	$12 47
52.2 pounds of reverted phosphoric acid,	4 18
92,4 pounds of insoluble phosphoric acid,	5 54
24. pounds of potassium oxide,	1 02
64.8 pounds of nitrogen,	14 90
	$38 11

Bradley's XL Ammoniated Bone Superphosphate.

(Collected of Parker and Gannet, Springfield, Mass.)

Guaranteed composition: soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; insoluble phosphoric acid, 2 to 3 per cent; potassium oxide, 2 to 3 per cent.; nitrogen, 2.5 to 3.25.

	Per cent.
Moisture at 100° C.,	15.80
Total phosphoric acid,	12.31
Soluble phosphoric acid,	8.37
Reverted phosphoric acid,	1.03
Insoluble phosphoric acid,	2.91
Potassium oxide,	2 64
Nitrogen,	3.10
Insoluble matter,	4.25

Valuation per two thousand pounds: —

167.4 pounds of soluble phosphoric acid,	$18 41
20.6 pounds of reverted phosphoric acid,	1 65
58.2 pounds of insoluble phosphoric acid,	3 49
52.8 pounds of potassium oxide,	2 24
62. pounds of nitrogen,	14 26
	$40 05

Bowker's Hill and Drill Phosphate.

(Collected of Fuller and Newton, Springfield, Mass.)

Guaranteed composition: total phosphoric acid, 10 to 12 per cent.; soluble and reverted phosphoric acid (available), 8 to 10 per cent.; potassium oxide (in form of sulphate), 2 to 4 per cent.; ammonia, 2.0 to 3.5 per cent. (equivalent to nitrogen, 1.7 to 2.88 per cent.).

	Per cent.
Moisture at 100° C.,	14.22
Total phosphoric acid,	10.31
Soluble phosphoric acid,	4.54
Reverted phosphoric acid,	1.77
Insoluble phosphoric acid,	4.00
Potassium oxide,	1.30
Nitrogen,	2.22

Valuation per two thousand pounds: —

90.8 pounds of soluble phosphoric acid,	$9 99
35.4 pounds of reverted phosphoric acid,	2 83
80. pounds of insoluble phosphoric acid,	4 80
26. pounds of potassium oxide,	1 82
44.4 pounds of nitrogen,	10 21
	$29 65

L. L. Crocker's Complete Manure.

(Collected of Fuller and Newton, Springfield, Mass.)

Guaranteed composition: soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 2 to 4 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; ammonia, 2.5 to 3.4 per cent. (equivalent to nitrogen, 2.1 to 3.0 per cent.); potassium oxide, 6 to 8 per cent.

	Per cent.
Moisture at 100° C.,	16.19
Total phosphoric acid,	10.94
Soluble phosphoric acid,	6 78
Reverted phosphoric acid,	1.53
Insoluble phosphoric acid,	2.63
Potassium oxide,	4.65
Nitrogen,	2.49

Valuation per two thousand pounds: —

135.6 pounds of soluble phosphoric acid,	$14 92
30.6 pounds of reverted phosphoric acid,	2 45
52.6 pounds of insoluble phosphoric acid,	3 16
93. pounds of potassium oxide,	3 95
49.8 pounds of nitrogen,	11 45
	$35 93

Dole's Common Sense Fertilizer (No. two).

(Collected of Parker and Gannet, Springfield, Mass.)

Guaranteed composition: total phosphoric acid, 4 to 8 per cent.; potassium oxide, 3 to 5 per cent.; ammonia, 3 to 6 per cent. (equivalent to nitrogen, 2.6 to 5.2 per cent.).

	Per cent.
Moisture at 100° C.,	23.51
Total phosphoric acid,	4.93
Soluble phosphoric acid,	.64
Reverted phosphoric acid,	3.30
Insoluble phosphoric acid,	1.26
Potassium oxide,	3.34
Nitrogen (in organic matter),	84
Nitrogen (in ammonia salts),	1 06

Valuation per two thousand pounds: —

12.8 pounds of soluble phosphoric acid,	$1 41
66. pounds of reverted phosphoric acid,	5 28
25.2 pounds of insoluble phosphoric acid,	1 51
66 8 pounds of potassium oxide,	2 84

16.8 pounds of nitrogen (in organic matter),	$3 86
21.2 pounds of nitrogen (in ammonia salts),	5 51
	$20 41

H. J. Baker and Bros. AA Ammoniated Bone Superphosphate.

(Collected of Fuller and Newton, Springfield, Mass.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 10 to 12 per cent.; potassium oxide, 2 to 3 per cent.; ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	12.11
Total phosphoric acid,	9.69
Soluble phosphoric acid,	8.63
Reverted phosphoric acid,	.27
Insoluble phosphoric acid,	.79
Potassium oxide,	2.38
Nitrogen (in organic matter),	.65
Nitrogen (in ammonia salts),	2.23
Insoluble matter,	2.97

Valuation per two thousand pounds: —

172.6 pounds of soluble phosphoric acid,	$18 99
5.4 pounds of reverted phosphoric acid,	43
15.8 pounds of insoluble phosphoric acid,	95
47.6 pounds of potassium oxide,	2 02
13. pounds of nitrogen (in organic matter),	2 99
44.6 pounds of nitrogen (in ammonia salts),	11 60
	$36 98

Bradley's Sea Fowl.

(Collected of Parker and Gannet, Springfield, Mass.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 8 to 10 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 3 per cent.; ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	12.82
Total phosphoric acid,	11.24
Soluble phosphoric acid,	8.44
Reverted phosphoric acid,	.66
Insoluble phosphoric acid,	2.14
Potassium oxide,	2.35
Nitrogen,	3.84

Valuation per two thousand pounds : —

168.8 pounds of soluble phosphoric acid,	$18 57
13.2 pounds of reverted phosphoric acid,	1 06
42.8 pounds of insoluble phosphoric acid,	2 57
47. pounds of potassium oxide,	2 00
76.8 pounds of nitrogen,	17 66
	$41 86

Stockbridge Manures, Potato.

(Collected of Fuller and Newton, Springfield, Mass.)

Guaranteed composition : total phosphoric acid, 8 to 10 per cent. ; soluble and reverted phosphoric acid (available), 7 to 8 per cent. ; potassium oxide (as sulphate), 5 to 6 per cent. ; nitrogen, 3.25 to 4.25 per cent.

	Per cent.
Moisture at 100° C.,	14.15
Total phosphoric acid,	8.62
Soluble phosphoric acid,	5.63
Reverted phosphoric acid,	.55
Insoluble phosphoric acid,	2.44
Potassium oxide,	4.26
Nitrogen,	4.09

Valuation per two thousand pounds ; —

112.6 pounds of soluble phosphoric acid,	$12 39
11. pounds of reverted phosphoric acid,	88
48.8 pounds of insoluble phosphoric acid,	2 93
85.2 pounds of potassium oxide,	5 96
81.8 pounds of nitrogen,	18 81
	$40 97

H. J. Baker and Bros.' Potato Fertilizer.

(Collected of Fuller and Newton, Springfield, Mass.)

Guaranteed composition : soluble and reverted phosphoric acid (available), 5.25 per cent. ; potassium oxide, 10 per cent. ; ammonia, 4 per cent. (equivalent to nitrogen, 3.3 per cent.).

	Per cent.
Moisture at 100° C ,	13.65
Total phosphoric acid,	7.31
Soluble phosphoric acid,	4.23
Reverted phosphoric acid,	1.61

	Per cent.
Insoluble phosphoric acid,	1.47
Potassium oxide,	9.68
Nitrogen (in organic matter),	1.67
Nitrogen (in ammonia salts),	2.30

Valuation per two thousand pounds: —

84.6 pounds of soluble phosphoric acid,	$9 31
32.2 pounds of reverted phosphoric acid,	2 58
29.4 pounds of insoluble phosphoric acid,	1 76
193.6 pounds of potassium oxide,	8 23
33.4 pounds of nitrogen (in organic matter),	7 68
46. pounds of nitrogen (in ammonia salts),	11 96
	$41 52

The Long Island Ammoniated Superphosphate with Potash.

(Atlantic and Virginia Fertilizer Co.; collected of Fuller and Newton, Springfield, Mass.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 8 to 11 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 5 to 7 per cent.; ammonia, 1 to 2.5 per cent. (equivalent to nitrogen, .8 to 2.1 per cent.).

	Per cent.
Moisture at 100° C.,	20.15
Total phosphoric acid,	12 63
Soluble phosphoric acid,	6.01
Reverted phosphoric acid,	1.82
Insoluble phosphoric acid,	4.80
Potassium oxide,	4 70
Nitrogen,	1.95

Valuation per two thousand pounds: —

120.2 pounds of soluble phosphoric acid,	$13 22
36.4 pounds of reverted phosphoric acid,	2 91
96. pounds of insoluble phosphoric acid,	5 76
94. pounds of potassium oxide,	4 00
39. pounds of nitrogen,	8 97
	$34 86

Soluble Pacific Guano.

(Collected of Parker and Gannet, Springfield, Mass.)

Guaranteed composition: soluble phosphoric acid. 6.5 to 8 per cent.; reverted phosphoric acid, 1.5 to 3 per cent.; insoluble phosphoric acid, 2 to 4 per cent.; potassium oxide, 2 to 3.5 per cent.; nitrogen, 2 to 3 per cent.

	Per cent.
Moisture at 100° C.,	13 42
Total phosphoric acid,	11.74
Soluble phosphoric acid,	5.11
Reverted phosphoric acid,	1.15
Insoluble phosphoric acid,	5 47
Potassium oxide,	2.05
Nitrogen (in organic matter),	2.60
Nitrogen (in nitrates),	.17
Insoluble matter,	5.90

Valuation per two thousand pounds: —

102.2 pounds of soluble phosphoric acid,	$11 24
23. pounds of reverted phosphoric acid,	1 84
109.4 pounds of insoluble phosphoric acid,	6 56
41. pounds of potassium oxide,	1 74
52. pounds of nitrogen (in organic matter),	11 96
3.4 pounds of nitrogen (in nitrates),	68
	$34 02

Mapes Tobacco Fertilizer.

(Collected of Fuller and Newton, Springfield, Mass.)

Guaranteed composition: total phosphoric acid, 7 to 7.5 per cent.; potassium oxide (in form of sulphate), 7 to 7.50 per cent.; ammonia, 5.75 per cent. (equivalent to nitrogen, 4.73 per cent.).

	Per cent.
Moisture at 100° C.,	15.18
Total phosphoric acid,	8.21
Soluble phosphoric acid,	1.95
Reverted phosphoric acid,	2.50
Insoluble phosphoric acid,	3.76
Potassium oxide,	7.36
Nitrogen (in organic matter),	.60
Nitrogen (in ammonia salts),	2.43
Nitrogen (in nitrates),	1.70
Insoluble matter,	1.23

Valuation per two thousand pounds: —

39. pounds of soluble phosphoric acid,	$4 29
50. pounds of reverted phosphoric acid,	4 00
75.2 pounds of insoluble phosphoric acid,	4 51
147.2 pounds of potassium oxide,	10 30
12. pounds of nitrogen (in organic matter),	2 76
48.6 pounds of nitrogen (in ammonia salts),	12 64
34. pounds of nitrogen (in nitrates),	6 80
	$45 30

Quinnipiac Phosphate.

(Collected of E. T. Sabin, East Amherst, Mass.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 8 to 10 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium oxide, 2 to 3 per cent.; nitrogen, 2.5 to 3.5 per cent.

	Per cent.
Moisture at 100° C.,	22.05
Total phosphoric acid,	12.99
Soluble phosphoric acid,	4.86
Reverted phosphoric acid,	5.82
Insoluble phosphoric acid,	2.31
Potassium oxide,	2.80
Nitrogen,	2.76

Valuation per two thousand pounds: —

97.2 pounds of soluble phosphoric acid,	$10 69
116.4 pounds of reverted phosphoric acid,	9 31
46.2 pounds of insoluble phosphoric acid,	2 77
56. pounds of potassium oxide,	2 38
55.2 pounds of nitrogen,	12 70
	$37 85

Bradley's XL Ammoniated Superphosphate.

(Collected of W. S. Wescott, Amherst, Mass.)

Guaranteed composition: total phosphoric acid, 9 to 11 per cent.; soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 3 per cent.; nitrogen, 2.5 to 3 per cent.

	Per cent.
Moisture at 100° C.,	14.08
Total phosphoric acid,	10.45
Soluble phosphoric acid,	8 42
Reverted phosphoric acid,	.63
Insoluble phosphoric acid,	1.40
Potassium oxide,	1.82
Nitrogen,	2.87

Valuation per two thousand pounds: —

168.4 pounds of soluble phosphoric acid,	$18 52
12.6 pounds of reverted phosphoric acid,	1 01
28. pounds of insoluble phosphoric acid,	1 68
36.4 pounds of potassium oxide,	1 55
57.4 pounds of nitrogen,	13 20
	$35 96

Complete Manure, Potatoes and Vegetables.

(H. L. Phelps, Northampton, Mass.)

Guaranteed composition: total phosphoric acid, 8 to 10 per cent.; soluble and reverted phosphoric acid (available), 5 to 6 per cent.; potassium oxide (as sulphate), 5 to 7 per cent; ammonia (in form of organic matter and ammonia salts), 4 to 5 per cent. (equivalent to nitrogen, 3.3 to 4.1 per cent.).

	Per cent.
Moisture at 100° C.,	12.08
Total phosphoric acid,	8.20
Soluble phosphoric acid,	4.80
Reverted phosphoric acid,	2.25
Insoluble phosphoric acid,	1.15
Potassium oxide,	4.62
Nitrogen (in organic matter),	1.87
Nitrogen (in ammonia salts),	1 82
Insoluble matter,	3.89

Valuation per two thousand pounds: —

96. pounds of soluble phosphoric acid,	$10 56
45. pounds of reverted phosphoric acid,	3 60
23. pounds of insoluble phosphoric acid,	1 38
37.4 pounds of potassium oxide,	8 60
36.4 pounds of nitrogen (in organic matter),	9 46
92 4 pounds of nitrogen (in ammonia salts),	6 47
	$40 07

IXL Ammoniated Bone Superphosphate.

(Geo. W. Miles' Co., Milford, Ct; collected of D. G. Wright, Northampton, Mass.)

Guaranteed composition: soluble and reverted phosphoric acid (available), 8 to 12 per cent.; potassium oxide, 1 to 3 per cent.; ammonia, 2.5 to 4 per cent. (equivalent to nitrogen, 1.6 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	19.04
Total phosphoric acid,	11.95
Soluble phosphoric acid,	6.94
Reverted phosphoric acid,	1.49
Insoluble phosphoric acid,	3.52
Potassium oxide,	1.83
Nitrogen,	2.25
Insoluble matter,	3.73

Valuation per two thousand pounds: —

138.8 pounds of soluble phosphoric acid,	$15 27
29.8 pounds of reverted phosphoric acid,	2 38
70.4 pounds of insoluble phosphoric acid,	4 22
36.6 pounds of potassium oxide,	1 56
45. pounds of nitrogen,	10 35
	$33 78

Bowker's Hill and Drill Phosphate.

(Collected of C. T. Brown, Northampton, Mass.)

Guaranteed composition: total phosphoric acid, 10 to 12 per cent.; soluble and reverted phosphoric acid (available), 8 to 10 per cent.; ammonia, 2.5 to 3.5 per cent. (equivalent to nitrogen, 2 to 2.8 per cent.); potassium oxide, 2 to 3 per cent. (in form of sulphate).

	Per cent.
Moisture at 100° C.,	15.50
Total phosphoric acid,	10.47
Soluble phosphoric acid,	8.26
Reverted phosphoric acid,	1.00
Insoluble phosphoric acid,	1.21
Potassium oxide,	1.85
Nitrogen,	2.42

Valuation per two thousand pounds: —

165.2 pounds of soluble phosphoric acid,	$18 17
20. pounds of reverted phosphoric acid,	1 60
24.2 pounds of insoluble phosphoric acid,	1 45
37. pounds of potassium oxide,	2 59
48.4 pounds of nitrogen,	11 13
	$34 94

Bowker's Lawn Dresser.

(Collected of C. T. Brown, Northampton, Mass.)

Guaranteed composition: total phosphoric acid, 6 to 8 per cent.; soluble and reverted phosphoric acid (available), 5 to 6 per cent.; potassium oxide, 4 to 5 per cent.; nitrogen, 4 to 5 per cent.

	Per cent.
Moisture at 100° C.,	10.83
Total phosphoric acid,	7.86
Soluble phosphoric acid,	5.09
Reverted phosphoric acid,	.64

	Per cent.
Insoluble phosphoric acid,	2.13
Potassium oxide,	3.71
Nitrogen,	5.06
Insoluble matter,	4.70

Valuation per two thousand pounds: —

101.8 pounds of soluble phosphoric acid,	$11 20
12.8 pounds of reverted phosphoric acid,	1 02
42.6 pounds of insoluble phosphoric acid,	2 56
74.2 pounds of potassium oxide,	3 15
101.2 pounds of nitrogen,	23 28
	$41 21

Bone Phosphate.

(A. L. Ames, Peabody, Mass.; collected by Chemist of Station.)

No guarantee obtained.

	Per cent.
Moisture at 100° C.,	12.38
Total phosphoric acid,	16.41
Soluble phosphoric acid,	4.60
Reverted phosphoric acid,	7.38
Insoluble phosphoric acid,	4.43
Potassium oxide,	.75
Nitrogen,	2.75
Insoluble matter,	.73

Valuation per two thousand pounds: —

92. pounds of soluble phosphoric acid,	$10 12
147.6 pounds of reverted phosphoric acid,	11 81
88.6 pounds of insoluble phosphoric acid,	5 32
15. pounds of potassium oxide,	64
55. pounds of nitrogen,	12 65
	$40 54

Clark's Cove Guano.

(Clark's Cove Guano Co., New Bedford, Mass.; collected of E. S. Snow, Belchertown, Mass.)

No guarantee obtained.

	Per cent.
Moisture at 100° C.,	22.95
Total phosphoric acid,	8.38
Soluble phosphoric acid,	6.39
Reverted phosphoric acid,	.07

	Per cent.
Insoluble phosphoric acid,	1.92
Potassium oxide,	2.30
Nitrogen (as organic matter),	.76
Nitrogen (as ammonia salts),	1.14
Nitrogen (as nitrates),	.29
Insoluble matter,	5.50

Valuation per two thousand pounds: —

127.8 pounds of soluble phosphoric acid,	$14 06
1.4 pounds of reverted phosphoric acid,	11
38.4 pounds of insoluble phosphoric acid,	2 30
46. pounds of potassium oxide,	1 95
15.2 pounds of nitrogen (organic matter),	3 50
22.8 pounds of nitrogen (ammonia salts),	5 93
5.8 pounds of nitrogen (nitrates),	1 16
	$29 01

APPENDIX.

COMPOSITION OF SOME COMPOUNDS IN FERTILIZERS.

One hundred parts of: —

Nitric acid contain 26 parts of nitrogen.

Ammonia contain 82.35 parts of nitrogen.

Pure nitrate of potassa (saltpetre) contain 53.4 parts of nitric acid and 46.6 parts of potassium oxide.

Pure nitrate of soda (Chili saltpetre) contain 63.25 parts of nitric acid.

Choloride of potassium contain 52.4 parts of potassium, 63.1 parts of potassium oxide, and 47.6 parts of chlorine.

Pure sulphate of potassa contain 54.9 parts of potassium oxide and 46 parts of sulphuric acid.

Bone phosphate (tricalcic phosphate) contain 46 parts of phosphoric acid and 54 parts of calcium oxide (lime).

Calcined gypsum contain 41 parts of calcium oxide and 59 parts of sulphuric acid.

Uncalcined pure gypsum contain 32.5 parts of calcium oxide, 46.5 parts of sulphuric acid, and 21 parts of water.

Carbonate of lime contain 56 parts of calcium oxide and 44 parts of carbonic acid.

Sulphate of magnesia (free of water) contain 33.3 parts of magnesium oxide (magnesia) and 66.6 parts of sulphuric acid.

C. A. GOESSMANN.

Amherst, Jan. 26, 1884.

SECOND DAY.

The committee on Times for Holding the Fairs reported that the date assigned to the Hillside Society should be the fourth Tuesday after the first Monday in September, and the following changes were asked and allowed: —

BERKSHIRE, second Tuesday after first Monday in September.
BRISTOL, fifth Tuesday after first Monday in September.
HAMPDEN, second Tuesday after first Monday in September.
HIGHLAND, first Wednesday after first Monday in September.
MIDDLESEX NORTH, second Tuesday after first Monday in September.

The Board then adjourned until two o'clock on Thursday.

THIRD DAY.

The Board met at ten o'clock, Mr. GRINNELL in the chair.

Present: Messrs. Barrus, Bird, Bowditch, Bowen, Buell, Buddington, Davis, Damon, Edson, Goddard, Grinnell, Haskell, Hartshorn, Hersey, Hill, Lane, Lynde, McKinstry, Moore, Nye, Noble, Slade, Smith, Varnum, Ware, Warner, Waterman and Wheeler.

Mr. Slade, chairman of the committee on Time and Place for Holding the Country Meeting, reported that they had attended to the duty, and recommended Great Barrington, December 2d, 3d and 4th.

Mr. HILL reported on the Union Society.

Voted, That the reports on the societies be accepted and referred to the Executive committee.

Voted, That the two vacancies made in the examining

committee of the Agricultural College, by the retirement of Messrs. Jewett and Slade, be filled by nomination made by the chairman, who presented the names of Messrs. Bird and Goddard, who were accepted.

His Excellency Governor Robinson came in and took the chair.

Voted, That the Board petition the legislature to authorize the Cattle Commissioners to investigate the extent and causes of the prevalent disease known by dairymen as abortion among cows, and to take such measures as may prevent or check it.

Voted, That in the opinion of the Board the last clause of the sixth section of the ninety-second chapter of the Public Statutes, commencing with the word "provided," shall be repealed, as being in effect prejudicial to the interests of agriculture. And the Secretary was instructed to present this vote to the chairman of the committee on Agriculture.

Mr. Grinnell took the chair.

Voted, That the committee on the College have further time to make their report and put it in the hands of the Secretary.

Voted, That the Secretary request all members of the Board, who have not furnished histories of their societies, to do so, that they may all be published in the same volume.

Voted, That the Scholarship offered by the American Veterinary College of New York be conferred upon Daniel C. Ashley of Foxborough, Mass.

Voted, That all unfinished business be referred to the Executive committee, with full powers.

Dr. Lynde, of the committee upon Essays and their assignment, reported as follows: —

"Farm and City." Alvan Barrus.
"Fruits of Orchard and Garden." J. H. Hill.
"Unimproved Land." Daniel Round.
"The Barn for the Farm." Jonathan Buddington.
"The Farmer's House." W. L. Warner.
"Trotting Horses." D. E. Damon.
"The Corn Crop." S. B. Bird.

Voted, That a committee of five be appointed to act with the Director of the Experiment Station in the examination of the lands in the Connecticut Valley, known as Montague Plains. Messrs. Grinnell, Smith, Haskell, Warner and Buddington were appointed such a committee.

Voted, That the Secretary be directed to petition the Legislature to amend section 99 of chapter 203 of General Statutes, so that the words "between the first day of April and the first day of December" shall be stricken out, and the effect of the statute be made to apply to the entire year.

Voted, That the Secretary petition the Legislature in aid of the continuance of the present laws under which the State Board of Health, Lunacy and Charity are made inspectors of food and drugs; and also for the increase of the appropriation for use of said Board.

The communication of the Master of the State Grange of Massachusetts was taken from the table, discussed and on motion of Mr. Hartshorn, was referred to the Executive committee.

Messrs. Wheeler, Noble, Waterman, Moore and Grinnell were appointed a committee on the Country Meeting.

Voted, That the Board of Agriculture petition the Legislature in aid of the petition of the Board of Control of the Experiment Stations at Amherst, for additional rooms to sufficiently conduct the required experiments, and that the Secretary of the Board send such a petition to the joint committee on Agriculture of the Legislature.

The committee on the Assignment of Delegates to the County Fairs, reported, by Mr. Warner, their chairman, the following assignments: —

Amesbury and Salisbury,	J. R. Nichols.
Barnstable,	A. C. Varnum.
Berkshire,	A. A. Smith.
Bristol,	J. Buddington.
Deerfield Valley,	M. I. Wheeler.
Essex,	J. P. Lynde.
Franklin,	E. A. Davis.
Hampden,	D. Round,
Hampden East,	J. O. McKinstry.
Hampshire,	D. E. Damon.
Hampshire, Franklin and Hampden,	J. H. Goddard.
Highland,	J. H. Hill.
Hingham,	C. L. Hartshorn.
Hoosac Valley,	Jas. S. Grinnell.
Housatonic,	A. P. Slade.
Hillside,	Wm. R. Sessions.
Marshfield,	H. C. Haskell,
Martha's Vineyard,	C. L. Buell.
Middlesex,	Alvan Barrus.
Middlesex North,	E. Hersey.
Middlesex South,	John Lane.
Nantucket,	W. L. Warner.
Plymouth,	S. B. Bird.
Union,	N. Edson.
Worcester,	H. Noble.
Worcester North,	L. C. Nye.
Worcester North-West,	E. F. Bowditch.
Worcester South,	Benj. P. Ware.
Worcester West,	W. S. Bowen.

The several papers that had been read, discussed and laid over, were taken from the table, read by their titles and accepted.

Adjourned.

JOHN E. RUSSELL,

Secretary.

THE FINANCES OF THE SOCIETIES.

FINANCES OF THE SOCIETIES.

SOCIETIES.	Amount received from the Commonwealth.	Income from Permanent Fund.	New Members and Donations.	All other Sources.	Receipts for the Year.	Premiums Offered.	Premiums and Gratuities Paid.	Current Expenses for the Year, not including Premiums and Gratuities.	Disbursements for the Year.	Indebtedness.	Value of Real Estate.	Value of Personal Estate.	Permanent Fund.
Amesbury and Salisbury,	$200 00	$49 56	$28 00	$273 00	$550 56	$300 00	$233 00	$309 44	$542 44	-	-	$1,180 27	-
Barnstable,	600 00	16 00	113 15	1,237 39	1,966 54	900 00	728 75	908 43	1,637 18	-	$6,000 00	800 00	$6,800 00
Berkshire,	600 00	572 56	264 00	3,104 00	4,540 56	3,368 00	2,883 50	2,077 59	4,956 09	-	8,000 00	700 00	8,700 00
Bristol,	600 00	-	413 40	8,240 27	9,253 67	4,500 00	3,836 25	4,408 94	9,544 59	$14,000 00	46,050 00	744 00	33,643 00
Deerfield Valley,	600 00	-	194 84	988 31	1,783 53	735 00	617 20	1,166 33	1,783 53	-	8,080 00	100 00	8,080 00
Essex,	600 00	1,391 41	237 50	566 96	2,795 87	2,745 00	1,802 00	899 80	2,701 80	-	5,000 00	1,000 00	18,212 81
Franklin,	600 00	42 11	72 50	2,249 66	2,964 16	931 50	770 10	825 55	2,963 48	-	10,000 00	1,000 00	11,000 00
Hampden,	462 26	-	71 25	141 19	674 70	1,640 00	408 66	302 72	711 38	-	-	-	-
Hampden East,	600 00	-	94 45	658 71	1,353 16	1,182 75	828 28	700 35	1,528 63	-	5,000 00	-	5,000 00
Hampshire,	600 00	-	204 82	1,055 50	1,860 32	745 00	701 90	827 65	1,754 55	885 23	4,100 00	150 00	3,300 00
Hampshire, Franklin and Hampden,	600 00	308 39	78 00	2,029 87	2,938 26	1,261 00	698 76	1,991 08	2,817 66	6,259 32	7,800 00	245 60	7,800 00
Highland,	600 00	27 00	34 50	1,125 94	1,787 44	862 30	570 20	1,070 76	1,640 96	-	2,500 00	800 00	3,300 00
Hingham,	600 00	-	324 40	2,712 55	3,636 95	1,534 15	661 10	2,347 58	2,994 68	1,900 00	16,000 00	2,000 00	16,100 00
Hoosac Valley,	600 00	-	344 00	3,493 30	4,437 30	1,589 50	1,268 75	2,231 15	4,193 64	4,900 00	12,900 00	450 00	-
Housatonic,	600 00	1,161 51	225 34	3,986 52	5,973 37	3,577 00	3,120 00	3,044 06	6,164 06	-	8,500 00	1,879 49	10,037 34
Hillside,	-	-	2,100 00	536 83	2,636 83	400 00	393 45	124 77	518 22	121 00	-	2 97	2,100 00
Marshfield,	600 00	-	40 00	1,332 20	1,972 20	1,200 50	826 87	1,758 10	2,717 12	5,051 96	11,806 92	1,392 78	8,147 74
Martha's Vineyard,	600 00	104 70	4 00	309 09	1,017 79	810 25	661 04	592 69	1,253 73	-	2,200 00	1,725 00	3,800 00
Massachusetts,	-	-	-	-	-	-	-	-	-	-	-	-	-
Middlesex,	600 00	-	93 00	2,357 10	2,450 10	1,576 00	742 00	1,510 13	2,252 13	20,000 00	15,000 00	-	4,000 00
Middlesex, North,	600 00	510 50	66 00	749 25	1,925 75	1,208 00	798 25	1,279 84	2,328 09	1,200 00	20,000 00	150 00	18,950 00
Middlesex, South,	600 00	-	114 65	-	1,531 94	1,061 75	874 00	583 80	1,457 80	12,500 00	18,000 00	-	5,500 00
Nantucket,	600 00	40 00	26 00	362 80	1,028 80	1,175 00	622 08	348 87	948 87	600 00	3,000 00	200 00	3,000 00
Plymouth,	600 00	200 00	343 90	5,254 92	6,398 82	3,082 00	2,477 19	3,921 63	6,398 82	7,753 06	43,000 00	2,000 00	38,000 00
Union,	600 00	64 36	135 36	1,472 35	2,228 71	1,349 00	900 24	1,915 78	2,816 02	-	6,350 00	1,435 06	7,785 06
Worcester,	600 00	-	156 00	6,167 83	7,567 77	2,600 00	1,628 00	2,220 92	7,567 77	35,000 00	100,000 00	10,000 00	100,000 00

Worcester, North,	600 00	-	209 50	2,125 78	2,935 28	957 25	833 75	1,495 63	2,329 38	11,600 00	16,000 00	482 40	482 40
Worcester, North-West,	600 00	-	77 50	2,652 00	3,329 50	1,631 75	1,146 38	1,594 35	3,940 73	4,800 00	12,500 00	1,451 47	9,151 47
Worcester, South,	600 00	-	136 00	2,753 13	3,489 13	1,927 25	1,434 70	1,581 73	3,052 18	-	13,500 00	1,000 00	14,500 00
Worcester, South-East,	-	-	-	-	-	-	-	-	-	-	-	-	-
Worcester, West,	600 00	-	24 00	1,664 73	2,368 73	1,481 50	1,146 42	1,075 82	2,368 73	1,356 51	11,600 00	750 00	11,600 00
	$16,262 26	$4,488 10	$6,226 06	$59,601 18	$87,397 74	$46,331 45	$33,612 82	$43,115 49	$85,884 26	$127,927 08	$412,886 92	$31,639 04	$358,989 82

PERMANENT FUND, — HOW INVESTED.

AMESBURY AND SALISBURY. — Deposited in savings bank.
BARNSTABLE. — In government bonds, real estate and personal property.
BERKSHIRE. — Real estate.
BRISTOL. — In real estate.
DEERFIELD VALLEY. — In real estate.
ESSEX. — In farm, bank stock and cattle pens.
FRANKLIN. — In park and buildings and bank stock.
HAMPDEN. —
HAMPDEN EAST. — In fair ground, buildings and fixtures.
HAMPSHIRE. — In real estate.
HAMPSHIRE, FRANKLIN AND HAMPDEN. — In real estate and personal property.
HIGHLAND. — In real estate, bank stock and personal notes.
HINGHAM. — In land, buildings and fixtures.
HOOSAC VALLEY. —
HOUSATONIC. — Real estate, railroad bonds and bank funds.
HILLSIDE. — In individual notes at interest.
MARSHFIELD. — In land and buildings.
MARTHA'S VINEYARD. — In land and buildings and notes at interest.
MASSACHUSETTS. —
MIDDLESEX. —
MIDDLESEX, NORTH. — In land and buildings.
MIDDLESEX, SOUTH. — In land and buildings.
NANTUCKET. — In land and buildings.
PLYMOUTH. — In real estate and personal property.
UNION. — In real estate, personal property and cash.
WORCESTER. — In real estate.
WORCESTER, NORTH. — In real estate.
WORCESTER, NORTH-WEST. — In land and buildings and cash.
WORCESTER, SOUTH. — In land and buildings.
WORCESTER, WEST. — In real estate.

ANALYSIS OF PREMIUMS AND GRATUITIES AWARDED.

SOCIETIES.	Total Amount offered for Management and Improvement of Farms, Orchards, etc.	Total Amount paid for Management and Improvement of Farms, Orchards, etc.	For Neat and Dairy Stock.	For Horses.	For all other Farm Stock.	Total Amount offered for Live Stock.	Total Amount paid out for Live Stock.	For Cereals and Seed.	For Roots and Vegetables.	Total Amount offered for Grain and Root Crops.	Total Amount paid out for Grain and Root Crops.	For Fruits, Flowers, etc.	For Dairy Products.	For Bread, Honey and Preserved Fruits, etc.	Total Amount paid out under the head of Farm Products.
Amesbury and Salisbury,	–	–	–	–	$13 00	–	$13 00	$3 50	$23 00	$84 00	$26 50	$73 50	$3 00	$10 50	$113 50
Barnstable,	$114 00	$18 00	$105 00	$28 00	227 50	$495 00	360 50	21 15	47 50	120 25	68 65	93 65	15 00	27 00	294 30
Berkshire,	184 00	184 00	474 00	229 00	292 00	1,353 00	995 00	228 00	116 00	441 00	422 00	133 00	53 00	47 00	577 00
Bristol,	160 00	121 00	607 00	172 00	253 50	1,387 50	1,032 50	8 00	121 00	260 00	121 00	165 50	46 00	27 50	359 50
Deerfield Valley,	–	–	171 00	128 00	136 95	516 00	435 95	8 50	10 50	24 25	23 00	38 30	13 00	15 90	109 20
Essex,	255 00	124 00	258 00	119 00	118 00	752 00	486 00	10 00	216 00	329 00	212 00	319 50	39 00	16 50	587 00
Franklin,	–	–	133 00	147 50	245 00	607 00	509 60	11 25	8 75	47 00	29 25	97 25	15 00	18 00	161 20
Hampden,	245 00	16 00	114 00	63 00	44 00	813 50	175 50	20 00	13 00	37 75	28 87	105 75	12 00	14 00	132 27
Hampden, East,	98 00	20 00	144 00	120 00	86 50	466 00	350 50	20 50	20 50	85 75	49 70	49 45	7 00	13 25	110 70
Hampshire,	–	–	99 00	96 00	173 00	458 00	272 50	9 50	19 50	68 00	51 00	71 00	13 00	20 00	155 00
Hampshire, Franklin and Hampden,	20 00	–	207 00	187 00	132 00	646 00	480 50	39 50	47 00	222 50	50 75	66 75	25 00	22 50	150 38
Highland,	40 00	30 00	137 75	121 00	85 75	546 50	344 50	20 50	30 25	54 00	50 75	12 75	9 50	8 60	81 60

Hingham,	187 00	11 00	130 00	50 00	158 25	716 75	338 25	–	39 40	177 00	39 40	129 05	13 75	17 35	199 90
Hoosac Valley,	60 00	60 00	94 00	166 00	221 00	656 00	481 00	139 00	73 75	235 00	212 75	97 50	42 00	45 00	397 25
Housatonic,	168 00	106 00	508 00	269 00	417 00	1,929 00	1,669 00	394 00	142 00	612 00	536 00	185 00	63 00	60 00	862 00
Hillside,	–	–	141 00	73 00	29 25	277 00	258 25	7 50	10 75	25 00	–	27 75	15 00	11 00	53 75
Marshfield,	73 00	25 75	163 00	55 00	97 25	482 50	309 25	21 00	71 25	99 00	92 25	85 85	23 00	36 25	237 35
Martha's Viney'd,	49 00	17 00	156 50	42 00	78 00	352 00	276 50	74 50	99 99	145 00	117 75	75 63	22 25	33 45	298 82
Massachusetts,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Middlesex,	–	–	73 00	64 00	350 00	651 00	214 00	2 00	52 00	119 00	36 00	202 00	1 00	35 00	271 55
Middlesex, North,	12 00	11 00	167 00	141 00	144 25	677 00	333 50	19 00	65 50	144 00	104 00	201 25	10 00	49 00	320 75
Middlesex, South,	63 00	45 00	126 75	49 00	80 00	540 00	256 25	22 25	19 50	145 25	41 75	66 15	2 00	16 75	126 65
Nantucket,	51 00	–	152 00	58 00	36 75	587 00	246 75	29 00	39 75	106 00	63 00	43 00	15 00	16 00	315 50
Plymouth,	161 00	72 00	485 92	173 00	207 52	1,000 00	866 44	106 00	71 00	369 00	177 00	166 00	54 00	31 75	428 75
Union,	16 00	4 50	250 50	105 00	85 25	742 50	422 00	17 50	14 50	72 00	37 50	19 75	15 00	8 80	81 05
Worcester,	–	–	392 00	109 00	95 00	1,850 00	634 00	28 00	37 00	114 00	92 00	352 50	18 00	3 50	427 00
Worcester, North,	21 00	21 00	136 50	–	124 50	440 50	254 50	16 75	16 00	52 00	31 75	153 00	10 00	16 50	199 75
Worcester, North-West,	22 00	19 00	235 00	121 00	129 00	811 00	477 81	31 00	11 00	57 00	39 67	46 75	17 00	12 00	105 50
Worcester, South,	100 00	15 00	331 00	601 00	186 30	1,242 00	1,107 00	34 00	14 75	97 00	57 00	91 75	29 00	22 00	199 75
Worcester, South-East,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Worcester, West,	65 00	22 00	303 00	128 00	74 00	1,126 00	950 50	750	16 25	79 00	23 75	32 97	22 00	11 00	216 22
	$2,164 00	$942 25	$6,294 92	$3,614 50	$4,320 52	$22,120 75	$14,551 05	$1,349 40	$1,467 39	$3,120 75	$2,835 04	$3,202 30	$622 50	$666 10	$7,483 19

ANALYSIS OF PREMIUMS AND GRATUITIES AWARDED — *Concluded.*

SOCIETIES.	For Agricultural Implements.	Offered for raising Forest Trees.	For Experiments on Manures.	Amount awarded for Objects strictly Agricultural not already specified.	Amount awarded and paid out for Trotting Horses.	For Objects not strictly Agricultural: Domestic Manufactures.	Number of Persons who received Premiums and Gratuities.
Amesbury and Salisbury,	$9 00	$10 00	–	–	–	$97 50	146
Barnstable,	–	7 00	–	–	$140 00	155 95	421
Berkshire,	29 00	–	–	–	730 00	368 50	615
Bristol,	148 00	23 00	$60 00	–	1,605 00	559 00	425
Deerfield Valley,	–	–	–	–	50 00	72 05	300
Essex,	29 00	40 00	25 00	–	–	202 75	317
Franklin,	–	10 00	–	–	485 00	105 60	250
Hampden,	23 00	30 00	15 00	$4 00	–	69 00	120
Hampden, East,	8 00	25 00	–	–	270 00	69 08	130
Hampshire,	–	8 00	–	–	225 00	170 90	165
Hampshire, Franklin and Hampden,	12 00	20 00	–	–	465 00	98 75	182
Highland,	1 00	–	–	–	14 00	99 10	180
Hingham,	–	50 00	–	–	–	111 95	301
Hoosac Valley,	18 00	–	10 00	32 50	1,030 00	280 00	321
Housatonic,	–	–	–	57 00	475 00	426 00	517
Hillside,	–	–	–	–	–	109 95	168
Marshfield,	19 25	50 00	–	–	164 00	123 72	429
Martha's Vineyard,	4 00	11 00	10 00	–	–	64 62	207
Massachusetts,	–	–	–	–	–	–	–
Middlesex,	12 00	50 00	–	–	410 00	101 90	165
Middlesex, North,	–	–	–	–	–	3 55	340
Middlesex, South,	7 00	30 00	–	–	245 00	194 10	118
Nantucket,	–	13 00	5 00	–	–	–	–
Plymouth,	–	60 00	–	–	828 00	238 50	427
Union,	3 50	–	–	32 50	235 00	143 30	226
Worcester,	18 00	11 00	–	–	455 00	100 00	240
Worcester, North,	23 00	25 00	–	–	195 00	204 80	239
Worcester, North-West,	9 25	30 00	–	50	487 00	70 54	167
Worcester, South,	10 00	35 00	–	–	465 00	68 90	175
Worcester, South-East,	–	–	–	–	–	–	–
Worcester, West,	13 00	30 00	10 00	–	480 00	55 70	217
	$396 00	$568 00	$135 00	$126 50	$9,453 00	$4,365 11	7,508

OFFICERS OF THE AGRICULTURAL SOCIETIES, 1884.

AMESBURY AND SALISBURY.

President — F. W. SARGENT of Salisbury.
Secretary — W. H. B. CURRIER of Salisbury.

BARNSTABLE.

President — AZARIAH ELDRIDGE of Yarmouth Port.
Secretary — F. PERCY GOSS of Barnstable.

BERKSHIRE.

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President — ALVAN BARRUS of Goshen.
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Secretary — J. F. WHITCOMB of Athol.

WORCESTER SOUTH.

President — BAINBRIDGE DOUTY of Charlton.
Secretary — C. V. COREY of Southbridge.

WORCESTER SOUTH-EAST.

President —
Secretary —

WORCESTER WEST.

President — CHAS. A. GLEASON of New Braintree.
Secretary — S. BOTHWELL of Barre.

AGRICULTURAL EXHIBITIONS, 1884.

AMESBURY AND SALISBURY *at Newburyport*, September 30 and October 1.
BARNSTABLE at *Barnstable*, September 23 and 24.
BERKSHIRE at *Pittsfield*, September 9, 10 and 11.
BRISTOL at *Taunton*, September 30, October 1 and 2.
DEERFIELD VALLEY at *Charlemont*, September 18 and 19.
ESSEX at *Haverhill*, September 23 and 24.
FRANKLIN at *Greenfield*, September 25 and 26.
HAMPDEN at *Chicopee*, September 9 and 10.
HAMPDEN EAST at *Palmer*, September 16 and 17.
HAMPSHIRE at *Amherst*, September 18 and 19.
HAMPSHIRE, FRANKLIN AND HAMPDEN *at Northampton*, Oct. 1, 2 and 3.
HIGHLAND at *Middlefield*, September 3 and 4.
HINGHAM at *Hingham*, September 23 and 24.
HOOSAC VALLEY at *North Adams*, September 16 and 17.
HOUSATONIC at *Great Barrington*, September 24, 25 and 26.
HILLSIDE at *Cummington*, September 23 and 24.
MARSHFIELD at *Marshfield*, September 10, 11 and 12.
MARTHA'S VINEYARD at *West Tisbury*, September 30 and October .
MIDDLESEX at *Concord*, September 23 and 24.
MIDDLESEX NORTH at *Lowell*, September 9 and 10.
MIDDLESEX SOUTH at *Framingham*, September 16 and 17.
NANTUCKET at *Nantucket*, September 3 and 4.
PLYMOUTH at *Bridgewater*, September 17, 18 and 19.
UNION at *Blandford*, September 17, 18 and 19.
WORCESTER at *Worcester*, September 18 and 19.
WORCESTER NORTH at *Fitchburg*, September 23 and 24.
WORCESTER NORTH-WEST at *Athol*, September 30 and October 1
WORCESTER SOUTH at *Sturbridge*, September 11 and 12.
WORCESTER WEST at *Barre*, September 25 and 26.

APPENDIX.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION,

AT AMHERST, MASS.

BOARD OF CONTROL, 1883.

His Excellency B. F. BUTLER,
Governor of the Commonwealth, President ex officio.

J. P. Lynde, ... Athol.
James R. Nichols, ... Haverhill.
Members of the State Board of Agriculture.

O. B. Hadwen, ... Worcester,
J. H. Demond, ... Northampton.
Members of the Board of Trustees of the Mass. Agricultural College.

Theodore Lyman, ... Brookline,
Member of the Massachusetts Society for Promoting Agriculture.

James C. Greenough, ... Amherst.
President of the Massachusetts Agricultural College.

OFFICERS APPOINTED BY THE BOARD OF CONTROL.

C. A. Goessmann, Prof. of Chemistry at the Mass. Agricultural College.
Director and Chemist.

M. Miles, Prof. of Agriculture at the Mass. Agricultural College.
Supt. of Field and Stock Experiments.

S. T. Maynard, Prof. of Botany at the Mass. Agricultural College.
Supt. of Horticultural Experiments, Microscopist and Draughtsman.

To the Secretary of the State Board of Agriculture.

Sir : — I herewith transmit to you for the approval of the Board and publication in your report to the Senate and House of Representatives the reports made by the officers of the Agricultural Experiment Station to the Board of Control.

O. B. HADWEN,
Secretary.

ANNUAL REPORT

OF THE

DIRECTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN :— I have the honor to present herewith respectfully the Annual Reports.

The real estate rented from the trustees of the Massachusetts Agricultural College consists of one dwelling house for offices and collection rooms, one barn with stables for stock-feeding experiments, and nineteen acres of land for field experiments. A few rooms set apart in the chemical department of the college serve as a laboratory for the execution of the chemical work of the station. The reconstruction of the buildings accepted by the Board has been devised and conducted by the committee appointed for that purpose; namely, the President of the college and Mr. Hadwen. The refitting of the barn and stables for stock-feeding experiments has been under the personal supervision of Professor M. Miles, and in the main according to plans of his submitted for consideration to the committee on buildings. A detailed description of this work, with illustrations, will be found in his report to the Secretary of the Board. The supervision of the field work has been divided between Prof. Miles and Prof. Maynard. To the former has been assigned sixteen acres in the vicinity of the farm buildings of the station; to the latter three acres near the plant-house in the botanical department of the college.

The field work of the station during its first year of active operations has been in several directions, and for obvious reasons of a preparatory character.

As the lands secured from the college consisted largely of grass land, of some pieces of winter grain — wheat — and

the experimental plats of the former for studying the growth of a variety of fruit and forage plants, it seemed for economical reasons best to secure the crops for the payment of the rents, and to prepare additional plats for field experiments, with reference to the limited financial resources at the disposal of the Board. Two and two-tenths acres of corn — in part for ensilage — and about one and one-half acres of a series of prominent forage crops, leguminous plants in particular, for comparative analysis regarding their relative feeding value, comprise the produce of the newly-arranged plats. A description of eleven underdrained plats, with an illustration of the entire work of underdraining, and of grading in a certain section of the farm land, and near the buildings designed for experimental work, will be found in the above stated report of Prof. Miles.

The same report contains the details of the cultivation of the corn, and of the filling of the silo, and of a feeding experiment with pigs, accompanied by the views of Prof. Miles regarding these matters.

The experiments concerning the effect of special mineral manures on the growth of fruit-bearing plants, and the character of the fruits produced by their assistance, which were inaugurated about ten years ago, have been continued for the past year. Two additional experimental plats of land were secured for the cultivation of fruit-trees, with the aid of the muriate of potash and the sulphate of potash, for the purpose of ascertaining their respective effect, in the interest of economy.

The cultivation of forage crops has received considerable attention, new varieties having been added to those cultivated in previous years. Collections at different stages of growth have been made, to ascertain their respective nutritive value. A description of the field work in connection with these experiments will be found in the appended report of Prof. S. T. Maynard, in whose particular care the lands occupied by small fruits, fruit trees and forage crops above referred to, have been during past years. Prof. Maynard's report contains also his experiments regarding the destruction of injurious insects and of fungi growth. His examination regarding the adulteration of field and garden seeds,

besides his inquiries concerning the best means for the destruction of the seeds of weeds, is fairly under way, and reports of the progress in these matters may soon be expected in the periodical publications of the Station.

The investigations concerning the characteristics of the "*fire worm*," the pest of the cranberry, with a view of ascertaining the means for its destruction, which, by a vote of the State Board of Agriculture, had been referred to the Station, has received a careful and generous attention, at my invitation, by Prof. W. S. Stearns, an entomologist by profession. The results of his work have been presented, in an able paper, at the late country meeting of the State Board of Agriculture, at Lowell.

The chemical department has been engaged to the full extent of its means. Most of its work has been already published in six monthly bulletins.

The analytical examinations comprise a series of articles sent on for that purpose by farmers' clubs; leading agricultural chemicals and other commercial manurial substances, not under control of the fertilizer laws; a variety of refuse material for the manufacture of home-made fertilizers; important commercial fodder substances, and leading farm crops.

The details of these investigations form the principal portion of the report of the chemist. This report contains also some statements regarding previous examinations, which have not been published in full in any State report, and, judging from frequent inquiries received, will prove of interest to some of the friends of progressive agriculture.

It has been the aim, in the management of the work of the Station, to meet promptly the direct applications of farmers' clubs, and the temporary wants of the farming community, and to prepare, as fast as circumstances enabled, and the thoroughness of the future work admitted, for experiments in field and barn.

Much work has been accomplished in both directions. Analyses of the drainage waters of the underdrained experimental plats, and of the crops raised upon the latter, as well as those raised on the remaining fields of the station, have been made, to serve as a basis for field and feeding experi-

ments during the coming season. The stables for feeding experiments are finished on a general plan, and require but limited expense and time to be fitted for special experiments in stock-feeding.

A considerable amount and variety of fodder raised upon the fields of the Station is on hand, to serve, in connection with the silo product, for feeding experiments.

Want of time and of means have thus far prevented the entering upon a systematic observation of the weather and the relation of the atmosphere on the physical and chemical condition of the soil. The observations which have been made in this direction are consequently rather fragmentary, and will be retained for the present, to be published when properly supplemented. One of the principal wants in the present stage of the Experiment Station consists in suitable rooms fit for careful observations of various kinds in agricultural chemistry and physics. The space at present occupied by the chemist consists of two rooms for general analytical work, for which they are well adapted. The remainder of the building, known by the name of "Chapel building," is occupied for various purposes by the college, and is decidedly inadequate to its daily-increasing wants. No more room can be obtained from the college authorities, nor can the restoration of the two rooms occupied by the Station meet the wants of the college. As the gas works of the Experiment Station are in connection with its present laboratory, and the building very suitable for the immediate wants of the experiments, as far as additional buildings are concerned, it seems, in the interest of economy, advisable to induce the college authorities to assign the entire building to the use of the Station, at a liberal rent; and to meet their wants by the erection of a new building, which they will be obliged to do at an early date. The best interests of both State institutions will be benefited by such an arrangement, which is presented for your careful consideration.

C. A. GOESSMANN,

Director.

REPORT OF SUPERINTENDENT

OF

FIELD AND FEEDING EXPERIMENTS.

To the Honorable the Board of Control of
The State Agricultural Experiment Station.

The following report of operations in the department of Field and Feeding Experiments for the year 1883 is respectfully submitted.

M. MILES,
Superintendent of Field and Feeding Experiments.

At the beginning of the present year an outline of a plan of experiments, in this department, was drawn up by me for the consideration of the Board, together with a plan for the required alterations in the old barn to fit it for the purposes of feeding experiments, and presented to Director Goessmann.

Having been informed that this plan of proposed experiments had been approved by the Board of Control, I was instructed by the Director of the Station to locate and stake out the proposed plats for the field experiments, and to construct the required drains, with provisions for collecting the drainage waters, to carry out the systematic investigations contemplated in the outline presented under the first subdivision of the approved plan.

The Field Plats.

After a careful examination of the area assigned for field experiments and a detailed study of its previous history as to cropping, with reference to its present agricultural condition, — in which I was materially aided by the advice and suggestions that were kindly given by Hon. Levi Stockbridge,

ex-president of the Agricultural College, — two series of plats were selected that presented the required conditions of uniformity and surface soil and exposure.

When the trenches for laying the tiles had been dug, it was likewise found that the subsoil in each series of plats was quite as uniform in its characteristics as the surface soil.

Through the liberality of Mr. W. W. Hunt of Amherst, who volunteered to furnish the tiles at actual cost, the Station had the benefit in their purchase of strictly wholesale rates.

The arrangement of the plats and the location of the drains will be readily understood by reference to the plan, in the supplementary paper, marked "Exhibit B."

The plats are two rods wide and eight rods long, giving an area of one-tenth of an acre each. To prevent any confusion as to locality, when referring to a particular plat, the east series of plats are designated by odd numbers, and the west series by even numbers.

The dotted line on the plan marks the boundary of an area that was cultivated as a vegetable garden for several years. From the heavy applications of manure that had formerly been made to this garden patch, the west series of plats should only be used for rotation experiments, which should be made to ascertain the influence of one crop upon the growth of another, and the influence of the system of cropping in conserving the elements of fertility, and upon the loss of fertilizing materials by drainage.

The east tier of plats (with odd numbers) have been under ordinary field culture, and for several years past in grass, which is badly "run out," the hay having been removed without the return of an equivalent in the form of manure; so that their present condition, as represented by their past history, is well adapted to the proposed permanent experiments with corn.

Drains.

A main drain of round tiles laid four feet deep has been made along the east side of each series of plats (four feet from the line of plats), with wells of sewer pipe opposite the middle of each plat, for the purpose of collecting samples of the drainage waters from the lateral drains which open

into them. The size of the tiles in the main drain is marked in red ink on the plan.

The laterals, of two-inch round tiles, are laid through the middle of each plat, and have their outlet in the wells twelve inches above the grade of the main drain.

From the great practical, as well as theoretical, importance of the experiments with drainage waters, extraordinary care has been taken in laying all of the tiles in the system of drainage, the slope or fall being the same in all cases to secure uniformity in their action, and to prevent the formation of pools of stagnant water within the range of the tiles to modify the composition of the drainage waters when the drains are running.

Culvert.

To secure an outlet for the main drain it was necessary to make a deep cut across the roadway on the south line of the experimental field, and make a new culvert to provide for the surface-drainage in the spring. This culvert is made of six-inch sewer pipe, resting on a wall of stones laid in cement to a depth of four feet below the line of pipes, to prevent the displacement of the sewer pipe by frost. A similar culvert was also made across the roadway on the north line of the experimental field.

In the construction of the main drains many large boulders were encountered in the lower twelve inches of the trench, which, together with the compactness of the clay and imbedded gravel, materially increased the cost of the work.

The work of digging trenches for the tile drains was begun April 16th, and the laterals on the east tier of plats were completed May 10th. From a delay in obtaining sewer pipe, the wells were not finished until some time afterwards.

Corn Experiments.

An account of the experimental crop of corn grown on the east series of plats, together with observations made on the drainage waters, will be found in the paper marked B, accompanying this report.

Drainage of Buildings.

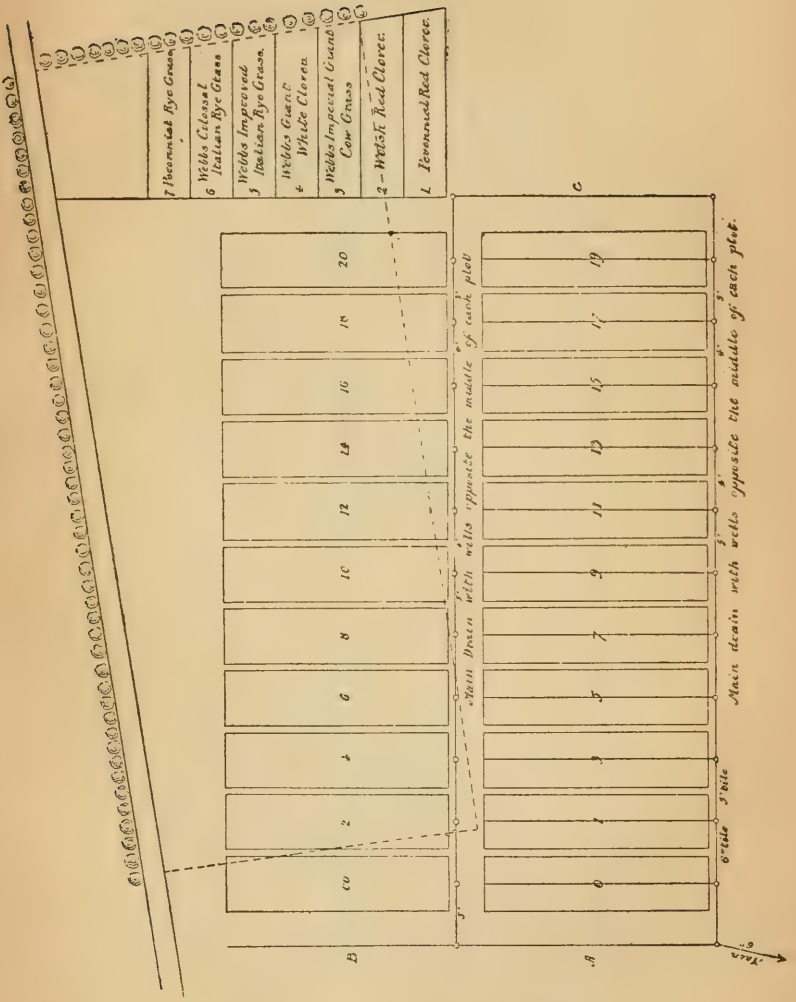
After every heavy rain in the spring the floor of the box stalls, the scale pit in the barn, and the cellar of the house, were flooded with water — the soil in the vicinity of the buildings being completely saturated, almost to the surface.

On the 6th of May I presented to Director Goessman a report of expenditures made by me in the work under my charge, together with estimates and recommendations in regard to the drainage of the buildings.

The construction of this system of drains having been authorized by the Board of Control, the work was begun by securing an outlet, by a junction with the main drain of the experimental plats, where it crosses the road on the south line of the experimental farm.

As a matter of economy, I can only repeat the recommendation made in the report of May 6th: that a six-inch tile should be laid from the culvert, where the present main has its outlet, to the small stream running across the farm, in order to secure a permanent outlet for the system of drains on the experiment farm.

In laying the main for the drainage of the buildings the same difficulties were encountered as in the case of the mains of the experiment plats, with the additional disadvantage of running water in the trenches, notwithstanding the work was done later in the season. A plan of these drains, showing their relation to the buildings, is given on the following page: —


7 Perennial Rye Grass
6 Wilks Celossal Italian Rye Grass
5 Wilks Improved Italian Rye Grass
4 Wilks Giant White Clover
3 Wilks Imperial Giant Cow Grass
2 – Welsh Red Clover
1 Perennial Red Clover
Main drain with wells opposite the middle of each plot
Main drain with wells opposite the middle of each plot
6" tile
5' tile
Trees
B
B
C

Forage Crops.

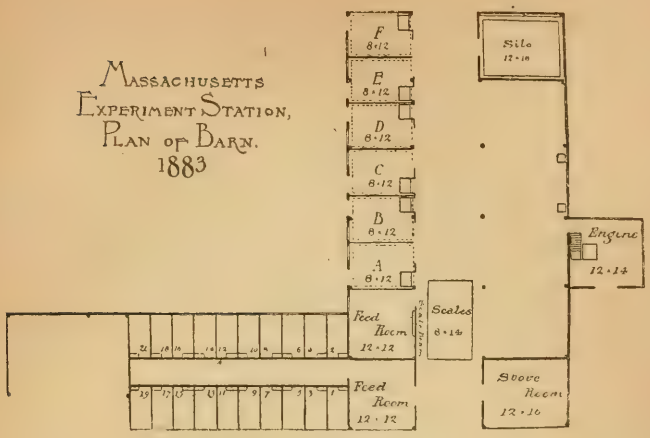
With the approval of Director Goessman, I ordered from England some seeds of forage crops, that seemed to be worthy of trial, which have been sowed on a series of plats just north of the plats heretofore described. From delays in transportation and detention in the custom house, the seeds were not sown until June 6th, the beginning of the dry season. Notwithstanding the unfavorable conditions of growth, the plants appear to be fairly well rooted, and the results for next summer will be looked for with interest. The varieties of seeds sown are marked on the plan of plats given in the report on corn experiments, marked "Exhibit B," as follows: —

1. Perennial Red Clover.
2. Welsh Red Clover, claimed to be "well adapted to land at all clover-sick."
3. Imperial Giant Cow Grass.
4. Giant Perennial White Clover.
5. Webb's Improved Italian Rye Grass.
6. Webb's Colossal Italian Rye Grass.
7. Perennial Rye Grass.

Feeding Barn.

The feeding barn was repaired and reconstructed, under my personal supervision, in accordance with the plan approved by the Board of Control, and under the advice and direction, from time to time, of Mr. O. B. Hadwen and Director Goessmann of the Building Committee. It is arranged with six box-stalls with cement floors, for feeding cattle and valuing manure, and twenty pens for feeding pigs and other small animals. There is also a silo, an engine-room, and feed-rooms, with convenient fittings for experiments.

The ground floor of the barn is given in outline on the following plan: —



The scales, manufactured to order with both metric and United States standard weights, were furnished by Fairbanks, Brown & Co. of Boston, at a very liberal discount from current rates.

Experiments.

When the barn was completed I was officially notified that the feeding experiments would be confined to the feeding of ensilage, and I was directed to superintend the construction of a silo to prepare for that work.

A description of the silo and the progress that has been made in the experiments with ensilage will be found in detail in the paper presented herewith, marked "Exhibit E."

The results thus far obtained are of great practical interest, as they seem to indicate the conditions that must be observed in preserving green crops in the form of ensilage, in order to secure a reasonable certainty in the results and a desirable uniformity in the quality of the product.

My opportunities for experimental work have been exceedingly limited, from the fact that most of my time has been spent in the personal supervision of the improvements in progress in the experiment field and in and around the buildings, as in the laying out of plats, the construction of drains, grading of the grounds, and making drive ways, etc., etc.

With the aid of my assistant, the work of making feed-bins, racks for drying experimental crops, fittings for pens and boxes, and other appliances for the purpose of experimentation, has been done in the intervals of other duties.

Hay.

The hay of the experimental farm was turned over to the college farm by Director Goessman, with the exception of the produce of certain areas, which I was requested to select for experiments in feeding, which is stored in the feeding-barn on the upper floor

Grounds.

The grounds around the building have been graded and seeded with a mixture of lawn grasses, and the road-bed of the carriage way in front of the buildings has been filled with stones and partly covered with gravel.

Pig Feeding.

Permission having been given me to "make any experiments that did not involve expense to the station," ten Berkshire pigs were placed in the pens October 18 and fed until December 17. The details and result of this experiment are herewith presented in the paper marked "Exhibit F."

In the supplementary papers presented with this report approximate estimates have been made of the additional facilities that are required in this department to carry on the work in a satisfactory manner.

Massachusetts Experiment Station,
Department of Field and Feeding Experiments,
Amherst, Dec. 22, 1883.

[Exhibit B.]

CORN EXPERIMENTS AND DRAINAGE.

Experiments with Indian Corn.

In accordance with the plan of experiments, approved by the Board of Control in January, corn was grown on the east series of plats (designated on the plan by odd numbers), without manure, and under the same conditions as to management, for the purpose of testing the relative fertility of the plats.

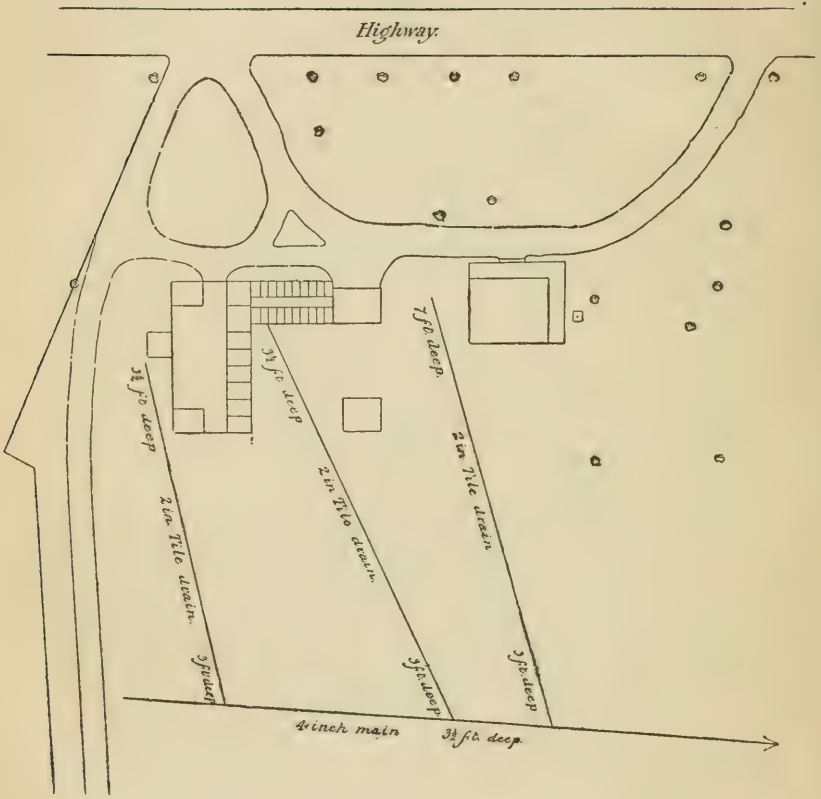
The arrangement of the plats and an outline of the drains are given on the accompanying plan. The plats, of one-tenth of an acre each, are two rods wide and eight rods long, and they are separated by a space four feet wide, on which no crop is grown.

The soil is a friable loam, with a retentive subsoil of clay that is nearly filled with gravel and small stones in the lower strata.

There is a remarkable uniformity in the soil and subsoil of the different plats, both as to apparent fertility and physical condition, with the exception of plat 0, where a large manure pile had formerly been made.

When the plats were laid out, it was readily seen, from the luxuriant growth of grass on plat 0, that it would not be comparable with the other plats under any conditions, but it was finally staked out, and added to the series as an extra plat, as it furnished the opportunity for studying the drainage waters of a soil highly manured.

In all operations of ploughing, cultivating, planting, hoeing and harvesting, the work was done lengthwise of the field, and consequently across the plats, so that each plat received the same treatment, as far as possible, both as to the amount of labor expended and the time in which it was performed.


Highway.
3½ ft. deep
2 in Tile drain.
3 ft. deep
3½ ft. deep
2 in Tile drain.
3 ft. deep
3½ ft. deep
2 in Tile drain.
3 ft. deep
3 ft. deep
4 inch main
3½ ft. deep

The plats were ploughed May 14, but from the heavy rains that soon followed, which are noticed in the account of the drainage, the after-cultivation was delayed until May 25, and the corn was not planted until a week later.

"Longfellow corn" was planted June 2, in hills, forty-four inches apart each way. The soil was in fine condition, and the plants came up evenly on the 8th inst., looking healthy and vigorous.

As the first and second days of June were the first really warm days of the season, the late planting did not at the time seem to be a serious disadvantage.

The cultivation of the crops was as follows: Cultivated, June 15; hand hoed, June 18; thinned to four plants in a hill, June 21; cultivated and hoed, without hilling, June 26, July 9 and 25; and a final hoeing, which was limited to killing the weeds that had survived the previous treatment, was given August 2.

The plats were quite free from weeds on the start, and the repeated cultivation and hoeing left the crop perfectly clean in its subsequent growth.

On the night of September 3 a hard frost severely injured the corn, and it should have been cut up the following day; but as we were dependent on the farm for labor, we were obliged to wait until the 7th inst., when the crop was cut close to the ground and put in stooks to cure. The leaves were considerably "wilted," but the stooks were not apparently injured.

The corn was husked October 18 by the "juniors," who volunteered their services, so that all the plats could be husked in one day. The corn and stalks were hauled to the barn and separately weighed, but the corn from plats fifteen, seventeen and nineteen was not weighed until the next morning. In Table I. the weight of corn and stalks is given for each plat: —

TABLE I.

PLATS.	No. of missing hills.	Sound Corn, lbs.	Soft Corn. Lbs.	Total Corn.	Stalks. Lbs.
0, ...	0	224.5	101.5	326.	578
1, ...	3	90.5	142.25	232.75	445
3, ...	2	91.5	136.	227.5	410
5, ...	2	103.	138.5	241.5	437.5
7, ...	4	98.5	123.	221.5	400.
9, ...	7	119.5	98.	217.5	383.
11, ...	5	115.5	104.	219 5	390
13, ...	5	88.	109.	197.	356
15, ...	3	46.5	127.5	174.	340
17, ...	6	52 75	138.75	191.5	355
19, ...	4	76.	143.	219.	400

It should be noted that from an error in making and planting, made by the unskilled hands assigned me, it became necessary to transplant several rows of corn on plats 13, 15 and 17, and that although the greatest care was taken in the work, the transplanted hills were checked in their growth and never fully matured. This will, in part at least, account for the lower yield of both stalks and corn on these plats.

The corn from plats 0, 1, 3, 5, 7, 13 and 19, was put in thin bags and placed on racks suspended by wires over the barn floor for further drying; and the stalks from plats 0, 1, 3, 5 and 7 were likewise separately stored, so that they could be again weighed.

These reserved samples were re-weighed November 17, with the results given in Table II. The loss in drying, per acre, is given in *italic*.

Both stalks and corn are still preserved for weighing at intervals during the winter and spring: —

TABLE II.

PLATS.	Sound Corn, lbs.	Soft Corn. lbs.	Total Corn. lbs.	Stalks. lbs.
0,	207.5	88.5	296.0	447.5
	170.0	*130.0*	*300.0*	*1305.0*
1,	83.0	122.5	205.5	345.0
	75.0	*197.5*	*272.5*	*1000.0*
3,	83.0	115.0	198.0	320.0
	85.0	*210.0*	*295.0*	*900.0*
5,	94.75	119.0	213.75	345.0
	82.5	*195.0*	*277.5*	*925.0*
7,	85.0	101.25	186.25	315.0
	135.0	*217.5*	*352.5*	*950.0*
13 ,.	79.5	91.25	170.75	
	85.0	*177.5*	*262.5*	
19,	67.25	123.5	190.75	
	87.5	*195.0*	*282.5*	

DRAINAGE WATERS FROM EXPERIMENTAL CORN PLATS.

As an introduction to this subdivision of my report, it may be well to make a condensed statement of some of the results of the latest researches in regard to the relations of the soil to the supplies of plant food which have prompted me to give such prominence to the investigation of drainage waters in the "Plan of Experiments," drawn up for the consideration of the Board of Control.

It has long been known that nitrogen, in some form, was essential in the processes of plant-growth, but its immediate source and the form in which it could be appropriated were matters of conjecture only, while the abundance of free nitrogen in the atmosphere furnished the basis of hypotheses that have not stood the test of experimental investigations.

The researches of Boussingault, in connection with the later and more exhaustive experiments of Lawes and Gilbert

and Righ at Rothamstead, seem to show conclusively that the free nitrogen of the atmosphere is not the direct source of the nitrogen of plants.

From later investigations it appears to be settled that most of our farm crops, and particularly the cereals, take up nitrogen only in the form of nitric acid; but it is perhaps probable that leguminous plants, and possibly Indian corn, may make use of nitrogen in organic combination, which is not available for other plants.

According to the latest report (1883) on the rainfall at Rothamstead, the total amount of combined nitrogen in the average annual rainfall, of twenty-nine inches, is estimated by Lawes and Gilbert and Warrington at 4.5 lbs. per acre, and they say, "As to the amount of gain by absorption by the soil, there is unfortunately no direct or satisfactory evidence at command. From such evidence as does exist, we are disposed to conclude that with some soils the amount will probably be greater, and with others less than that supplied by the rainfall."

It will not, therefore, be safe to estimate the atmospheric supplies of nitrogen at more than 10 lbs. per acre, annually, and this must be obtained through the medium of the soil, the direct absorption of the ammonia of the air, by plants, being so slight that practically it need not be noted.

As our farm crops contain on the average from twenty-five to considerably more than one hundred pounds of nitrogen per acre, we must look to the soil and to the manures applied as the principal source of available nitrogen.

A large part of the nitrogen of the soil is in organic combination, but nitrogen in this form, as well as that in nitrogenous organic substances and ammonia salts that are applied as manure, must be transformed into nitric acid before it is available for plant growth.

But little has been known in regard to this process of nitrification until within a few years past, notwithstanding the theories that have been formed to account for it.

From the experiments of Schloessing and Muntz, which were first published in 1877, it is evident that the nitrification of soils is caused by a living organism, which acts as a

ferment, and they afterwards, by a system of cultivations, isolated and identified the specific form as a member of the family of bacteria.

The experiments on nitrification made by Warington at Rothamstead in 1877, 1878, and 1879, have fully substantiated the claims of the French chemists, and furnished additional information of practical value in regard to the *rôle* of the bacterium that performs such an important part in the process of vegetable nutrition.

These bacteria abound in every fertile soil, and as a function of their vital activity are constantly transforming the nitrogen of organic substances and of ammonia, in the surface soil, into nitric acid, when the proper conditions of moisture and temperature are present.

The bacteria of nitrification are most active at a temperature of about 99° F. — they act slowly when the temperature is lowered to near the freezing point, or when it is raised to 122° F., and at 131° F. their peculiar function as a ferment ceases.

Another important condition is essential to rapid nitrification, namely, the presence of an excess of some salifiable base, as carbonate of calcium, so that nitrates can be readily formed. This accounts for the action of lime when applied to peaty soils, which has not heretofore been satisfactorily explained.

The nitrates, as found, may be at once taken up by the roots of living plants, or, in their absence, they will be washed by the rains to the lower strata of the soil beyond the reach of shallow-rooted plants, or they may be lost entirely in the drainage waters.

It must therefore be seen that the nitrification of soils, and the conservation of the nitrogen in the form of nitrates are biological processes involving the activities of living organisms.

During the summer the process of nitrification is carried on rapidly, and the nitrates are taken up by the growing crops; but after harvest, on cropped land — and where land is fallowed — the nitrates accumulate in the surface soil until the fall rains wash them down to the lower strata.

A few examples from the experiments at Rothamstead will sufficiently illustrate the behavior of the nitrates in the soil.

The soil of the drain-gauges at Rothamstead (of $\frac{1}{1000}$ of an acre in area), is unmanured and uncropped, representing in fact the conditions of a bare fallow. The loss of nitrogen in the drainage waters of the gauge, sixty inches deep, amounted to 42.64 pounds per acre annually on the average for five years. This loss was distributed as follows: —

For the three months January–March, . .	9.92 pounds per acre.
For the three months April–June, . . .	6.10 pounds per acre.
For the three months July–September, . .	10.80 pounds per acre.
For the three months October–December, .	15.82 pounds per acre.
Total, ...	42.64 pounds per acre.

On land cropped continuously with wheat, the loss of nitrogen in the drainage waters was estimated as follows: On plats that received no nitrogenous manures, the average loss for two seasons of excessive drainage was from 15 to 17 pounds of nitrogen per acre, while the average for thirty years was from ten to twelve pounds per acre.

Where from 43 to 129 pounds of nitrogen was applied in the form of ammonia salts, the loss of nitrogen by drainage was estimated at from 19 to 42.4 pounds per acre annually.

These experiments with drainage waters have been supplemented by an extended and systematic examination of the soils.

In the Hoos field, which has been alternately in wheat and fallow since 1851 without manure, samples of the soil were taken in September, 1878, with the following results: —

DEPTH.	NITROGEN AS NITRATES IN LBS. PER ACRE.	
	From half of the field in wheat.	From half of the field in fallow.
First 9 inches, ...	2.6	28.5
Second 9 inches, ...	Trace.	5.2
Total in 18 inches, ...	2.6 lbs.	33.7 lbs.

The wheat had evidently taken up the nitrates as they had been formed, and losses of nitrogen by drainage would not be likely to take place until after harvest. "In three soils

at Rothamstead, in fair agricultural condition, cultivated as bare fallows since the harvest of the previous year, 56.5, 58.8 and 59.9 pounds of nitrogen, as nitric acid, per acre, were found in September or October to the depth of 27 inches. If the summer has been dry, the nitrates are near the surface; after much rain they are at a lower level.

Without further discussion of these valuable and interesting experiments, it will be clearly seen that the work of experimentation in this field of research can no longer be retarded by the vague and indefinite problems presented by former crude theories. From our present knowledge of the process of nitrification, and of the relations of the elements of fertility to the soil under different conditions, all of which is largely owing to the remarkable series of experiments conducted at Rothamstead for the past forty years, the lines of investigation that give promise of immediately practical results are well defined and can be readily followed.

Experiments are now needed to determine the applicability of the results obtained at Rothamstead to the different climatic conditions that prevail in this country. That the general relations of the plant-food to the soil are the same cannot be doubted; but we need information as to the modifying influences of the varied conditions.

Drainage Waters of the Experimental Corn Plats.

In the selection and arrangement of the experimental corn plats, as well as in the construction of the drains, particular care has been taken to secure uniformity in all conditions that could possibly have an influence on the composition of the drainage waters.

When the work of digging the trenches for the tiles was begun, April 16, the soil was saturated with water within about twelve inches of the surface.

The water table was of course lowered as the drains were laid, and for some time before the last laterals were finished, May 10, the two-inch drains had stopped running, and there was but little water even in the main drains. A heavy rain fell on the night of May 21, and continued through the following day.

The drains on plats 3 and 13 and the "headers" B and C, were running at 10 A.M. on the 22d inst., and at 11 A.M. all the drains were running with the exception of the one on plat 19.

Samples of the drainage waters, for analysis, were taken from plats 0, 3, 13, and from the "header" C. That from plat 0 was not clear.

At 1.30 P.M. all the drains were running, and the water was clear, with the exception of that from plat 7, which was slightly turbid. The drains from plats 15, 17 and 19 discharged less than the others.

At 2.30 P.M. samples of the drainage waters were taken for analysis from all the plats and from the headers B and C. At 5 P.M. the header C was running full, the drains on plats 0, 1 and 3 nearly full, and all others more than half full.

Later in the evening all the drains were running full. On the 23d inst. all the drains were running a good stream at 11 A.M., and the discharge from the laterals continued until June 2, heavy showers having fallen on the 28th and 31st of May. The samples of drainage waters were taken to the laboratory, where they were analyzed under the supervision of Director Goessmann, with the results given in the following Table: —

Composition of the Drainage-waters from the Experimental Corn Plats, May 22, 1883.

PLAT.	Time of taking Samples.	PARTS PER MILLION.							GRAINS PER GALLON.			
		Free Ammonia.	Albuminoid Ammonia.	Total Ammonia.	Nitrogen as Ammonia.	Nitrogen as Nitrates.	Total Nitrogen.	CaCo 3 (Hardness).	Solids.	Potassium Oxide.	Phosphoric Acid.	Chlorine.
0,	11 A. M.	.13	.09	.22	.18	.70	.88	27.3	7.5	.18	Trac e.	.4
0,	2.30 P. M.	.11	.06	.17	.14	–	.14	16.9	5.0	.15	Trace.	.4
1,	2.30 "	.08	.11	.19	.16	16.26	16.42	*	*	*	*	*
3,	11 A. M.	.01	.07	.08	.07	.27	.34	28.6	4.5	.13	Trace.	.5
3,	2.30 P. M.	.45	.06	.51	.42	.19	.61	19.5	2.5	.13	Trace.	.3
5,	2.30 "	.02	.07	.09	.07	–	.07	23.4	2.5	.11	Trace.	.3
7,	2.30 "	01	.10	.11	.09	.05	.14	27.3	4.5	.18	Trace.	.3
9,	2.30 "	.02	.09	.11	.09	.06	.15	23.4	3.5	.14	Trace.	.4
11,	2 "	.01	.10	.11	.09	.09	.18	22.1	4.0	.09	Trace.	.2
13,	11 A. M.	.01	.08	.09	.07	.17	.24	22.1	4.0	.12	Trace.	.3
13,	2 P. M.	.01	.10	.11	.09	.13	.22	20.8	3.8	.21	Trace.	.3
15,	2 "	.01	.07	.08	.07	.03	.10	26.0	4.5	.04	Trace.	.3
17,	2 "	.01	.10	.11	.09	.05	.14	45.7	9.0	.07	Trace.	.3
19,	2 "	.01	.12	.13	.11	.17	.28	41.6	9.0	.31	Trace.	.4
C,	11 A. M.	.01	.12	.13	.11	.14	.25	18.2	2.3	.07	Trace.	.5
C,	2 P. M.	.01	.15	.16	.13	–	.13	15.6	3 3	.04	Trace.	.4
B,	2.30 "	.01	.11	.12	.10	.07	.17	18.2	2.5	.03	Trace.	.3

* Not determined.

The exceptionally high yield of nitrogen in the drainage water from plat 1, as given in the Table, can only be explained on the supposition that the labels of the samples from plats 0 and 1, collected at 2.30 P.M., have been transposed, either when sampling in a pouring rain or afterwards. The composition of the sample of plat 1, as given in the Table, is approximately what might be expected in the sample from plat 0, from what is known of its characteristics and previous history. The record is, however, given as it was made, and future analysis of the drainage waters from these plats may explain the apparent anomaly.

There was quite as much nitrogen in the drainage waters of most of the plats as could reasonably be expected under the conditions and at the time of year when they were collected.

The soluble nitrogen of the soil had been washed out by the spring rains before the tiles were laid, and during the cold and backward spring the process of nitrification had not been carried on actively.

The composition of the drainage waters may have been somewhat modified by the conditions under which they were collected, as they were the first waters discharged by the tiles that had just been laid.

The season has been a remarkably dry one, and the drains have not been running since June 2.

The water table was raised to the grade of the main drain by the fall rains, but the laterals have remained dry.

To carry out these experiments in a manner that will secure the best practical results in the shortest time, three drain-gauges should be provided to determine the relations of the rainfall to the drainage under different conditions of management, — and laterals should be laid in the upper tier of plats, which should be devoted to crops in systematic rotation.

The entire expense of these additional facilities for experimenting will probably not exceed $450.

In a matter of so much importance to the farmers of the State, there should be no difficulty in securing the required appropriation.

It is certainly bad policy to buy fertilizers to supply a waste of the elements of fertility in the soil, which may be prevented by better methods of management; and these can only be determined by carefully conducted experiment.

[Exhibit E.]

REPORT ON ENSILAGE.

Silo.

The silo, 10.5 by 14.1 feet, inside measure, and 11 feet deep, for experiments with ensilage, has been made in one corner of the feeding barn, and entirely above ground.

In its construction the aim has been to secure a practically air-tight box with the least possible expense.

The lower two feet of the silo is enclosed with brick walls, nearly two feet in thickness, which form on two sides the foundation walls of the building, the earth on the outside being graded nearly to the level of the sills.

Above the brick work the walls of the silo are made with six-inch studs, in contact with the sheathed and clapboarded covering of the barn on two sides, and the inner walls are covered with matched boards on the outside. The lining of the silo consists of two thicknesses of one-inch matched boards, nailed firmly to the studs, with sheets of tarred paper between them to make the walls as nearly air-tight as possible. In this way a dead-air space of six inches is secured in the walls on all sides.

Door.

The door of the silo, opening on the barn floor, is made of pieces of two-inch planks, planed to a thickness, and battened with a lining of one-inch planed boards. These pieces forming the door are placed crosswise of the doorway, fitting closely inside the jambs, with the inner surface flush with the inside of the wall of the silo. The door is kept in place by planed 2 by 4 scantling, fastened to the jambs of the doorway with square-headed screw bolts, technically called "lag-screws," to sustain the pressure of the ensilage on the door.

By this arrangement access is gained to the ensilage by taking out the lag-screws with a wrench, and removing the scantling that support the door, and then taking the door out piece by piece, and thus exposing the wall of ensilage pressing against it.

The cover of the silo consists of a course of two-inch planed planks, cut five-eighths of an inch shorter than the diameter of the silo, and covered with a course of one-inch planed boards breaking joints with the planks. As the planed surface and edges of the boards and planks fit closely together, the cover is practically air-tight, with the exception of the slight space around the edges which must be left to prevent binding against the walls of the silo as the ensilage settles.

Weights.

The required pressure is obtained by means of cement barrels filled with earth.

Barrels or boxes of earth or stones are, in my experience, the best and most convenient weights for a silo, as they give a uniform and constant pressure. Screws are objectionable as they do not give a constant pressure and must be tightened once or twice a day for several weeks, and the labor involved is more than will be required to supply the needed load of earth or stones.

Fodder Corn.

The fodder corn for filling the silo was grown on the west tier of experiment plats, and on a small piece of ground west of the plats in experimental grasses.

No manure was applied, as the condition of the soil for future experiments was a matter of greater importance than a large crop of fodder corn this year.

"Longfellow" corn was sowed in drills thirty inches apart July 5. From the late time of planting, a small variety of corn was selected in preference to the larger sorts, which require a longer season to mature.

The corn made a rapid growth, and it was well tasselled out, when it was struck by the frost on the night of Sept. 3.

As soon as help could be obtained the fodder corn was harvested and put in the silo, the cutting to $1\frac{1}{4}$ inch lengths being done by hand-power.

15212.5 pounds were cut and put in the silo Sept. 6; 13850.0 pounds were cut and put in the silo Sept. 7; and 5327.5 pounds, harvested the preceding day, were cut and put in the silo Sept. 8. The total of green fodder was 17 tons 390 lbs.

The corn was well tramped down as it was put in the silo, and at night when work was stopped the surface was carefully levelled and left without covering until morning.

The night of the 6th the mass settled about two inches, and on the night of the 7th it settled three inches.

The cover was put on and weighted with earth to give an estimated pressure of something over 60 pounds to the square foot, in the afternoon of the 8th.

The mass, before covering and weighting, filled the silo to the depth of $8\frac{1}{2}$ feet, and the temperature two feet below the surface was 82° F.

Temperature.

For the convenience of future observations a gas pipe $1\frac{1}{4}$ inches in diameter and four feet long, with sharp edges, was driven through a hole in the middle of the cover, and the upper end was securely packed to make a tight connection with the planks of the cover, while the top was closed with a plug.

The temperature of the ensilage at the bottom of this tube, and the temperature of the air outside, together with the settling of the surface of the mass of ensilage, were frequently observed with the results given in the following table. Whenever a change in the temperature was noticed the observation was immediately repeated, to eliminate all possible errors. The observations on the depth of ensilage were taken from a single point until the 18th inst., when irregularities in the rate of settling were noticed, and the observations were afterwards taken from four points, the average of them being given in the table: —

Observations on the Ensilage.

DATE.	Depth of Ensilage.	Temperature of Ensilage 4 ft. from the surface.	Temperature of Outside Air.	Remarks.
Sept. 8, . .	8 ft. 6 in.	82° F.	–	2 ft. below surface before covering.
" 9, . .	7 " 7 "	82° "	–	
" 10, . .	7 " 2¾ "	78° "	–	
" 11, . .	6 " 9 "	77° "	–	
" 12, . .	– –	82° "	62°	
" 14, . .	– –	84° "	55°	
" 15, . .	5 ft. 11½ in.	84° "	68°	
" 16, . .	5 " 11¼ "	87° "	72°	
" 17, . .	5 " 10½ "	85° "	69°	
" 18, . .	5 " 9¾ "	82° "	59°	
" 19, . .	5 " 9¾ "	84° "	–	
" 20, . .	5 " 9½ "	84° "	61°	
" 21, . .	5 " 9¼ "	84° "	62°	
" 22, . .	5 " 9 "	83° "	56°	
" 24, . .	5 " 9 "	82° "	61°	
" 25, . .	5 " 8½ "	80° "	58°	
" 26, . .	5 " 8¼ "	80° "	50°	
" 27, . .	5 " 7¾ "	80° "	50°	
" 28, . .	5 " 7½ "	80° "	60°	
" 29, . .	5 " 7¼ "	79° "	53°	
" 30, . .	5 " 7¼ "	78° "	59°	
Oct. 1, . .	5 " 7⅛ "	78° "	50°	
" 2, . .	5 " 7⅛ "	76° "	48°	
" 3, . .	5 " 7 "	76° "	44°	
" 4, . .	5 " 6⅞ "	76° "	43°	
" 10, . .	– –	68° "	–	
" 27, . .	– –	65° "	–	
Nov. 7, . .	– –	64° "	–	
" 18, . .	– –	59° "	–	
Dec. 3, . .	– –	54° "	–	
" 15, . .	5 ft. 5½ in.	49° "	22°	

It will be seen that the ensilage did not settle at a uniform rate, as might be expected from the constant pressure applied, and the variations are greater than can be attributed to errors of observation, as the measurements were taken with the greatest exactness, and they were repeatedly verified by re-measurement. Frequent examinations of the edges of the cover failed to detect any indication of obstruction by pressure on the walls of the silo.

Temperature.

The temperature of the ensilage on the 9th inst. was the same as on the previous day, before the cover was put on

(82°), but there was a fall of 5° in the course of the next two days. A rise of temperature then followed, reaching the maximum of 87° on the 16th, and during the next two weeks there was a depression of but 9°. The fall in temperature in the following two and one half months was only 29° to the lowest observation recorded (49°), which is still above the temperature of the outside air.

Bacteria.

Samples of the ensilage were taken from time to time through the tube, at depths of from four to five feet below the surface, for microscopic examination.

The sample taken on the 9th inst., when the temperature was observed, swarmed with bacteria, which were remarkably active, and rapidly increasing by self-division.

Since the temperature has fallen below 60° the apparent activity of the bacteria has been slightly diminished. This may be attributed to the lower temperature and increasing acidity, but the relative influence of each has not been determined.

Fermentation.

There are two classes of ferments now generally recognized: 1st, the so-called soluble or chemical ferments, as acids and diastase, which "invert" cane sugar and transform it into dextrose, or change starch into dextrine, etc., and these, according to Dumas, "always sacrifice themselves in the exercise of their activities." 2d, The true ferments, which from the discoveries of Schwann (1838), and the elaborate and exhaustive experiments which have been made by Pasteur in the past twenty years, are now known to be living organisms that produce fermentation as a function of their vital activity.

The true fermentations are, therefore, purely physiological processes, which are defined by Pasteur as "the direct consequence of the processes of nutrition, assimilation and life, when they are carried on without the agency of free oxygen," or "as a result of life without air." Unlike the soluble ferments, these living organisms increase at the expense of the substances fermented.

These organized ferments, which belong to the class of fungi, may be divided into two groups, the *Saccharomycetes* or budding fungi, — the active agents of alcoholic fermentation, of which yeast may be taken as the type; and the *Schizomycetes*, or fission fungi, which include the lactic, butyric, and similar ferments, and the ferments of putrefaction; most of them are of the forms known as bacteria, and they multiply rapidly by subdivision. All the members of both groups probably propagate by means of spores, but this method of reproduction has not been observed in many species belonging to the last mentioned group.

The living organisms of fermentation found in samples of fresh ensilage, all belong to the group of Schizomycetes (bacteria). No members of the group of Saccharomycetes (yeast or alcoholic fungi) have been observed in samples from the interior of the silo that had not been exposed to the air.

After the silo is opened and a large surface is exposed to the air, the "yeast fungi" and even the "moulds" may be found, but they are evidently the result of germs derived from the air after the silo is opened.

We do not include the "mould fungi" in the class of ferments proper, as Pasteur has shown that they act as ferments under exceptional conditions only, and even then they do not produce active fermentation.

The ferments of the first mentioned group have been studied more thoroughly than the others, from their importance in the manufacture of beer, wine, etc., but many of the facts developed in their investigation are undoubtedly applicable to the ferments of the other groups.

From experiments with fruits in an atmosphere of carbonic acid, Pasteur has apparently shown that any vegetable cells which are capable of extracting their needed supply of oxygen from organic combinations may, by this manifestation of their vital activity, act as ferments; and the true ferments are distinguished from these, not by a difference in their specification, but from the fact that they are capable of carrying on the functions of nutrition and assimilation with much greater activity without a supply of oxygen in the air.

Pasteur has likewise proved that the alcoholic ferments

develop rapidly in the presence of air, but their function as ferments is impaired by this ready supply of oxygen.

In the absence of air, as in an atmosphere of carbonic acid, they take their supply of oxygen from organic substances, like sugar, and their function as ferments is increased.

When the life of the bacteria, or other organized ferments, is destroyed, the process of fermentation, or putrefaction, ceases; and this takes place, — according to the observations made in the course of the controversy in regard to spontaneous generation,— at a temperature of from 122° to 140°, and if the germs that produce the bacteria are then excluded, the process of fermentation, or of putrefaction, cannot again take place.

The canned articles of food, which are now so common in the markets, furnish an illustration of the application of this principle. In their preparation heat is applied, which kills the bacteria, — the active agents of fermentation, — and they are then sealed in air-tight cans to prevent the access of a fresh supply of germs from the atmosphere.

That the germs which produce the bacteria of fermentation and putrefaction are abundantly distributed in the air, has been conclusively proved by the experiments of Pasteur and Tyndall, and the supposed cases of spontaneous fermentation or putrefaction are readily explained by the seeding of the fermenting substances with the germs derived from the atmosphere.

The various and conflicting reports that are made in regard to the quality of ensilage, including the degree of acidity, its influence upon the quality of milk, and its general feeding value, can only be explained by differences in the quality and maturity of the crops from which it is made, together with the different methods of securing it, all of which must have an influence on the process of nutrition in the bacteria, and therefore produce variations in the results of fermentation.

The molecular changes taking place under such different conditions cannot be expressed in any definite chemical formula. As fermentation is strictly a physiological process, the fermented product may be looked upon as the *residuum*

of what is required in the nutritive functions of the bacteria that produce it.

In advocating these views Pasteur says: "Originally, when fermentations were put amongst the class of decompositions by contact-action, it seemed probable, and, in fact, was actually believed, that every fermentation had its own well-developed equation, which never varied.

"In the present day, on the contrary, it must be borne in mind that the equation of a fermentation varies essentially with the conditions under which that fermentation is accomplished, and that a statement of this equation is a problem no less complicated than that in the case of the nutrition of a living being. To every fermentation may be assigned an equation in a general sort of way, — an equation, however, which in numerous points of detail is liable to the thousand variations connected with the phenomena of life. Moreover, there will be as many distinct fermentations brought about by one ferment as there are fermentable substances capable of supplying the carbon element of the food of that same ferment, in the same way that the equation of the nutrition of an animal will vary with the nature of the food which it consumes. As regards fermentation producing alcohol, which may be effected by several different ferments, there will be, in the case of a given sugar, as many general equations as there are ferments, whether they be ferment-cells, properly so called, or cells of the organs of living beings functioning as ferments. In the same way the equation of nutrition varies in the case of different animals nourished on the same food. These remarks are applicable to all ferments alike; for instance, butyric ferment is capable of producing a host of distinct fermentations, in consequence of its ability to derive the carbonaceous part of its food from very different substances, from sugar, or lactic acid, or glycerine, or mannite, and many others. Moreover, it is quite erroneous to suppose that the presence of a single one of the products of a fermentation implies the co-existence of a particular ferment. If, for example, we find alcohol among the products of a fermentation, or even alcohol and carbonic acid gas together, this does not prove that the ferment must be an alcoholic ferment, belonging to alcoholic fermentations

in the strict sense of the term. Nor, again, does the mere presence of lactic acid necessarily imply the presence of lactic ferment. As a matter of fact, different fermentations may give rise to one or even several identical products."

From this statement of the physiological conditions that modify the products of fermentation, it must be seen that uniformity in the quality of ensilage can only be secured by preventing fermentation altogether, or reducing it within the narrowest possible limits. This can only be done by destroying the bacteria of fermentation in the earliest stages of their activity, which would result in the production of ensilage free from acidity, and closely resembling in quality the green fodder from which it is made.

If the bacteria can be killed, when the silo is covered and weighted, the enclosed mass of ensilage will be practically preserved under the same conditions as fruits, or vegetables, or meats are preserved when canned. The practical question, then, presents itself as to how this can best be accomplished.

An extended series of observations on samples of the ensilage from the experimental silo, have already been made, and are still in progress, to determine the temperature required to kill the bacteria which are the cause of fermentation. This will, without doubt, vary somewhat with the kind of produce under treatment and its condition at the time of harvest. Thus far my experiments seem to indicate that a temperature of from 115° to 122°, maintained for one or two hours, will be sufficient to kill the bacteria under the conditions in which they are now placed.

The time of exposure, as well as the temperature, must have an important influence on the result.

A degree of heat that would kill the mature and active bacteria would not, in all probability, kill the germs which might produce a succeeding generation if the given temperature was continued but a short time.

From observations on the temperature of the silo after it was covered and weighted, it may with reason be expected that the initial temperature will remain nearly constant for several days, and perhaps for weeks, which would ensure the destruction of any successive generations of bacteria that

might be developed from the germs that had not been killed.

In the ordinary process of filling a silo the object aimed at is to prevent fermentation by keeping the green fodder well packed as it is put in, and even under these precautions the temperature of the mass often rises above 100°. I have observed a temperature of 105° when the greatest care had been taken in packing the silo as it was filled.

With less tramping of the mass, and when the work of filling the silo is extended over a period of several days, the temperature may rise to a point that is fatal to the bacteria; and this may be the explanation of the reported cases in which the ensilage is said to be "sweet," or free from acidity.

When the precise conditions as to the required temperature are known, the better plan may be to fill the silo without any packing beyond what is produced by the weight of the superincumbent mass, and then allow it to remain until the desired temperature is reached, before putting on the cover and weights.

The best method can, however, only be determined by carefully conducted experiments that are made with a full knowledge of the different conditions that may have an influence in modifying the results. It cannot, however, be doubted that acidity in the ensilage can only be produced by conducting the process so that the temperature does not rise above the point that is fatal to the bacterial ferment (probably 115° to 120°).

In filling silos, observations on temperature have been generally neglected, and we therefore lack the necessary data for determining the precise temperature required to prevent fermentation, or the conditions under which it may be produced, from the results of practical experience. But a single case has come to my knowledge, where such observations have been made, when the resulting product was sweet ensilage. Mr. George Fry of England reports the results of some experiments made the present season, which are of particular interest in connection with the observations recorded above.

In a silo, filled with "rough grass" and "clover and rye

grass" between the 7th and 30th of June, the temperature at the time of covering was 132°, at a depth of six feet from the surface. The cover was weighted with twelve inches of sand.

On July 11th, and again on the 17th, the cover was taken off and the silo was filled with "meadow grass" to make up for the loss in settling.

The temperature observed at these dates was 140° at a depth of six feet from the surface.

In another silo, filled with "clover and rye grass" and "meadow grass" between June 30th and July 11th, when the cover was put on and weighted, the temperature observed was — July 7th, 149°, and July 14th, 158°. The first-mentioned silo was opened October 25, and the ensilage is described as "of a brown color, and of a sweet, luscious odor, *free from acidity*, very much resembling that of ordinary hay." Cattle, sheep, and horses ate it at once with apparent relish.

These experiments seem to prove that a temperature sufficiently high to kill the bacteria and put a stop to fermentation can be readily obtained in the process of filling the silo.

Experiments are now needed to determine the precise temperature required and the most favorable conditions for securing it with different articles of food.

Ensilage in the Silo.

To carry on the experiments now in progress, the ensilage in the experimental silo should not be fed out until some time in March.

Additional facilities will be required to complete the investigations that are now in progress. An appropriation of $100.00 will be sufficient to provide the necessary outfit.

An engine is very much needed to furnish power for cutting fodder, and for other purposes, — a suitable one, with the necessary shafting and belting, may be procured at a cost not exceeding $500.

Amherst, Mass., Dec. 24, 1883.

[Exhibit F.]

EXPERIMENTS WITH PIGS.

The experiments in pig-feeding have been limited to some preliminary inquiries in regard to the influence of bran and cotton-seed meal when added to a ration composed principally of corn-meal.

As bran and cotton-seed meal contain a higher percentage of proteids than corn-meal, they should be valuable additions to the ration, if corn-meal as a fattening food is deficient in nitrogenous constituents. Ten pure-bred Berkshire pigs, from the College farm, were put in the experimental pens on the afternoon of October 23, but one pig being put in each pen. The age, sex, and weight of each pig is given in the following table: —

No. 1, Sow, weight, October 23,	58¾ lbs.	Born May 16, 1883.
" 3, " "	59¾ "	
" 5, Barrow, "	59¼ "	
" 7, " "	42¼ "	
" 9, " "	68¼ "	From two to three weeks older.
" 10, " "	70 "	
" 8, " "	61¼ "	
" 6, Sow, "	67½ "	
" 4, Barrow, "	60¼ "	
" 2, " "	59¼ "	

For a preliminary period of five days, while getting accustomed to their new quarters, the pigs were all fed on corn-meal.

At the beginning of the experiment, on the morning of October 29, they were all again weighed, before feeding, and were then put on their assigned rations as follows: —

Nos. 5 and 6, — Corn-meal only.
Nos. 1, 2, and 8, — Corn-meal with cotton-seed meal.
Nos. 3, 7, and 4, — Corn-meal with bran.
Nos. 9 and 10, — Corn-meal with bran and cotton-seed meal.

A limited ration of bran and cotton-seed meal was given in the pens having the mixed food, and the corn-meal was fed to make out the full ration of as much as would be readily eaten.

The bran and cotton-seed meal were not apparently relished on the start, and the amount fed was determined in each case by the quantity that would be eaten with a good appetite.

An analysis of the feed was made in the laboratory, under the supervision of Director Goessman, which showed the composition to be as follows: —

	Corn-Meal.	Bran.	Cotton-Seed Meal.
Moisture, at 100° C.,	13.55	12.08	8.38
Crude Ash,	1.23	6.96	7.80
" Cellulose,	2.28	12.06	6.17
" Fat,	3.67	3.35	11.85
" Protein,	8.99	13.78	38.91
Non-nitrogenous Extract,	70.28	51.77	26.89
	100.00	100.00	100.00

To prevent any possible deficiency in the ash constituents, in feeding growing pigs with corn-meal alone, and to secure uniformity in all conditions, aside from the differences in food, leached ashes, with a few small pieces of charcoal, were kept in a separate trough in each pen, to which the pigs had uninterrupted access.

The weight of each pig at the beginning of each week, the feed consumed per week, and the average weight of each pig for each week, will be found in Tables 1, 2, and 3.

The amount of dry substance of food consumed per week by each pig, the amount of dry substance of food required to produce one pound of increase in live weight, and the gain for each 100 pounds of live weight, or the gain per cent. for each week, is given in Tables 4, 5, and 6.

Table No. I.

Weight of Each Pig at beginning of Preliminary Period, Oct. 23, and at the beginning of Each Week of the Experiments, — Weights taken Monday Mornings before feeding, from Oct. 29, 1883, — in Pounds and Decimals of a Pound.

DATE — 1883.	1	3	5	7	9	10	8	6	4	2
October 23, ...	58.75	59.75	59.25	42.25	68.25	70.0	67.5	61.25	60.25	59.25
" 29, ...	58.0	61.0	61.5	43.5	71.5	71.0	70.0	63.75	62.00	63.25
November 5, ...	60.5	68.5	59.5	46.5	78.0	77.75	73.5	67.75	65.00	72.75
" 12, ...	68.0	73.5	57.	47.5	85.5	81.25	82.75	75.25	71.25	76.00
" 19, ...	73.0	81.75	63.5	54.0	91.75	90.5	87.5	81.25	78.00	83.75
" 26, ...	77.0	87.0	70.0	57.0	103.75	95.5	104.25	90.5	85.00	92.00
December 3, ...	81.0	86.0	76.75	58.5	109.0	101.5	97.0	97.25	91.50	87.00
" 10, ...	79.5	87.5	84.5	59.0	115.5	104.0	105.5	104.5	98.00	83.5
" 17, ...	77.	87.5	85.0	60.0	121.0	103.0	102.25	110.0	–	–

Table No. 2.

Feed Consumed, per Week, by each Pig in Pounds and Decimals.

PERIOD.	1.		3.		5.	7.		9.			10.			8.		6.	4.		2.	
	Corn-meal.	Cotton-seed Meal.	Corn-meal.	Bran.	Corn-meal.	Corn-meal.	Bran.	Corn-meal.	Bran.	Cotton-seed Meal.	Corn-meal.	Bran.	Cotton-seed Meal.	Corn-meal.	Cotton-seed Meal.	Corn-meal.	Corn-meal.	Bran.	Corn-meal.	Cotton-seed Meal.
Preliminary period, Oct. 23 to 29, .	16.75	–	18.75	–	20.5	16.5	–	21.5	–	–	21.	–	–	22.13	–	21.5	20.13	–	20.13	–
Week ending Nov. 5, . . .	15.31	2.85	20.5	5.88	20.75	9.5	5.75	21.	5.75	2 88	19.5	5.44	2.66	18.16	2.13	27.31	21.	5.63	23.63	3.94
Week ending Nov. 12. . . .	15.88	2.63	24.94	5 25	11.13	10.5	5.25	21.	5.25	2.63	19 75	4.94	2.47	24.19	3.25	27.56	21.	5.25	21.13	3.94
Week ending Nov. 19, . . .	15.75	2.63	24.94	5.25	15.69	10.5	7.75	20.5	4.88	2.56	20.25	4.81	2.53	18 63	3.81	28.19	21.	5.25	21.	3.94
Week ending Nov 26, . . .	17.25	2.63	24.94	5.25	23.13	10.5	7.88	21.	5.25	2 63	19.	4.75	2.38	23.13	5.25	28.88	21.	6.56	18.5	3.47
Week ending Dec. 3, . . .	18.38	2.63	19.13	4.13	26.69	10.5	9.19	20.5	5.13	2 56	18.	4.5	2.1	18.	3.63	30.63	21.	7.88	14.25	2.79
Week ending Dec. 10, . . .	18.56	2.44	12.63	3.69	29.94	10.5	7.69	21.	5.25	2.63	15.75	3.94	1.31	18.	3.69	32.56	21.	7.88	7.06	1.94
Week ending Dec. 17, . . .	11.63	.88	15.88	2.	20.94	11.25	4.06	20 25	6.34	2.56	15.44	1.88	1.	15.75	1.13	28.13	–	–	12.	–

Table No. 3.

Average Weight of Pigs for Each Week in Pounds and Decimals.

DATE—1883.	1	3	5	7	9	10	8	6	4	2
October 23 to October 29, . . .	58.38	60.38	60.38	42.88	69.88	70.50	68.75	62.5	61.13	61.25
Week ending November 5, . . .	59.25	64.75	60.50	45.00	74.75	74.38	71.75	65.75	63.5	68.00
" " " 12, . . .	64.25	71.00	58.25	47.00	81.25	79.50	78.13	71.5	68.13	74.38
" " " 19, . . .	70.5	77.63	60.25	50.75	88.63	85.88	85.13	78.25	74.63	79.88
" " " 26, . . .	75.0	84.38	66.75	55.5	97.75	93.00	95.88	85.88	81.50	87.88
" " December 3, . . .	79.0	86.5	73.38	57.8	106.4	98.50	100.6	93.9	88.30	89.5
" " " 10, . . .	80.25	86.75	80.63	58.75	112.25	102.75	101.25	100.83	94.75	85.25
" " " 17, . . .	78.25	87.5	84.75	59.5	118.25	103.5	103.88	107.25	–	–

Table No. 4.

Dry Substance of Feed consumed, per Week, for each 100 lbs. of Live Weight in Pounds and Decimals.

DATE—1883.	1	3	5	7	9	10	8	6	4	2
October 23 to 29,	24.8	26.9	29.4	33.3	26.7	25.8	27.9	29.8	28.5	28.5
Week ending November 5,	25.1	35.3	29.2	31.6	35.3	32.7	24.6	35.9	36.5	30.1
" " " 12,	25.2	35.5	16.6	29.2	31.0	28.7	30.6	33.4	33.4	29.7
" " " 19,	22.7	32.5	24.2	31.3	26.4	28.1	21.8	31.2	30.5	27.3
" " " 26,	23.1	29.7	33.0	28.8	25.8	24.6	25.9	29.1	29.4	16.8
" " December 3,	23 2	23.4	31.5	28.1	23.1	21.8	23.0	28.2	28.4	16.7
" " " 10,	22.8	15.3	32.2	26.9	22.4	17.9	17.7	27.9	26.4	9.5
" " " 17,	13.9	18.3	21.4	22.4	21.5	15.4	13.1	23.8	–	–

TABLE No. 5.

Dry Substance of Feed consumed required to produce 1 lb. of increase of Live Weight.

DATE—1883.	1	3	5	7	9	10	8	6	4	2
October 23 to 29, ...	*	11.6	7.9	11.4	5.7	18.2	7.7	7.4	9.4	4.4
Week ending November 5, . . .	5.5	3.0	*	4.6	4.0	3.6	5.1	5.9	7.7	2.3
" " " 12, . . .	2.1	5.0	*	13.7	3.4	6.7	2.6	3.2	3.6	6.7
" " " 19, . . .	3.2	3.1	2.2	2.4	3.9	2.9	3.9	4.1	3.4	2.8
" " " 26, . . .	4.4	4.8	3.1	5.3	2.1	4.6	1.5	2.7	3.4	1.7
" " December 3, . . .	4.6	*	3.4	10.9	4.7	3.6	*	3.9	3.9	*
" " " 10, . . .	*	8.8	3.3	32.0	3.9	7.4	2.1	3.9	3.9	*
" " " 17, . . .	*	*	36.2	13.3	4.6	*	*	4.4	–	–

* No gain.

TABLE NO. 6.

Gain per 100 lbs. of Live Weight per Week.

DATE—1883.	1	3	5	7	9	10	8	6	4	2
October 23 to 29	—1.3	2.1	3.8	3.0	4.8	1.4	3.7	4.1	5.0	6.8
Week ending November 5, . . .	3.4	12 3	—4.1	6.9	9.1	9.5	5.0	6.3	4.8	15.0
" " " 12, . . .	12.39	7.3	—2.5	2.2	9.6	4.5	12 6	11.1	9.6	4.5
" " " 19, . . .	7.3	11.2	11.4	13.1	7.3	11.4	5.7	8.0	9.5	10.2
" " " 26, . . .	5.3	6.2	9.8	5.4	12.3	5.4	17.5	10.8	8.6	9.4
" " December 3, . . .	5.2	—1.2	9.6	2.6	5.1	6.3	—7.6	7.5	7.6	—5.9
" " " 10, . . .	—1.9	1.7	10.1	0.9	6.0	3.4	8.7	7.4	7.1	—4.
" " " 17, . . .	—3.1	0.	0.6	1.7	4.8	—1.0	—3.1	5.2	–	–

In the diagrams which follow, some of the leading facts recorded in the tables are presented in the graphic form, so that the results can be more readily compared.

The different pigs, and the kind of feed consumed by them, is indicated on all the diagrams as follows: —

A black line is given for pigs 5 and 6, which were fed corn-meal only.

A blue line is given for pigs 1, 2 and 8, which were fed corn-meal with cotton-seed meal.

A red line is given for pigs 3, 7 and 4, which were fed corn-meal with bran.

An interrupted line, blue and red, is given for pigs 9 and 10, which were fed corn-meal with bran and cotton-seed meal.

A scale at the side of the diagrams will show the weights indicated.

On diagram 1, the actual weight of each pig is given for each week, and the gain or loss can be readily traced.

In diagram 2, the initial weights are reduced to a common standard of one hundred pounds, and the lines show the gain or loss for each week for each one hundred pounds of live weight.

The dry substance of feed consumed per week, for each one hundred pounds of live weight, is given in diagram 3, and the dry substance of food consumed, required to produce one pound of increase in live weight, is given in diagram 4.

It will be noticed that the weights of pigs 4 and 2 are omitted in the tables and diagrams the last week of the experiment. No. 4 seemed to be in perfect health, when weighed on the morning of December 10, but a few minutes after he fell down in a "spasm," and died within ten minutes of the first attack, apparently of apoplexy. The only post-mortem indications of disease consisted in congestion of the membranes of the brain and medulla.

An examination will show that, in the uniform rate of gain during the experiment, — in the comparatively slight variations in the amount of food consumed in proportion to its weight, — and in the return for feed consumed, he had made one of the best records in the experiment.

Diagram 1. Weight of each pig at the beginning of the preliminary period - Oct. 23rd - and at the beginning of each week of the experiment.

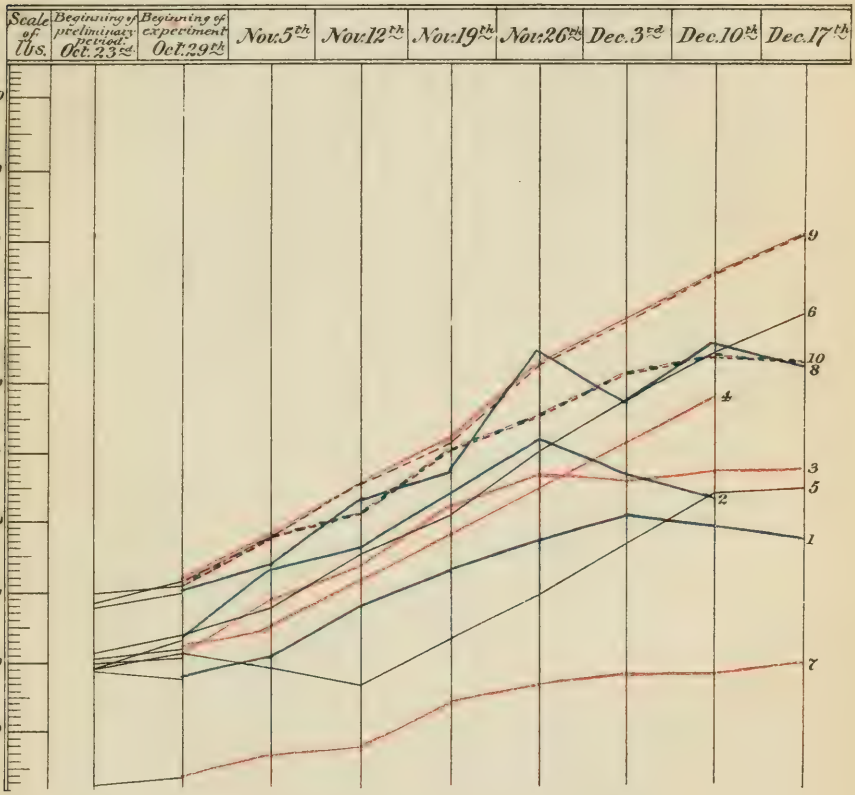


Diagram 2. Gain per each 100lbs. of live weight per week, or gain per cent.

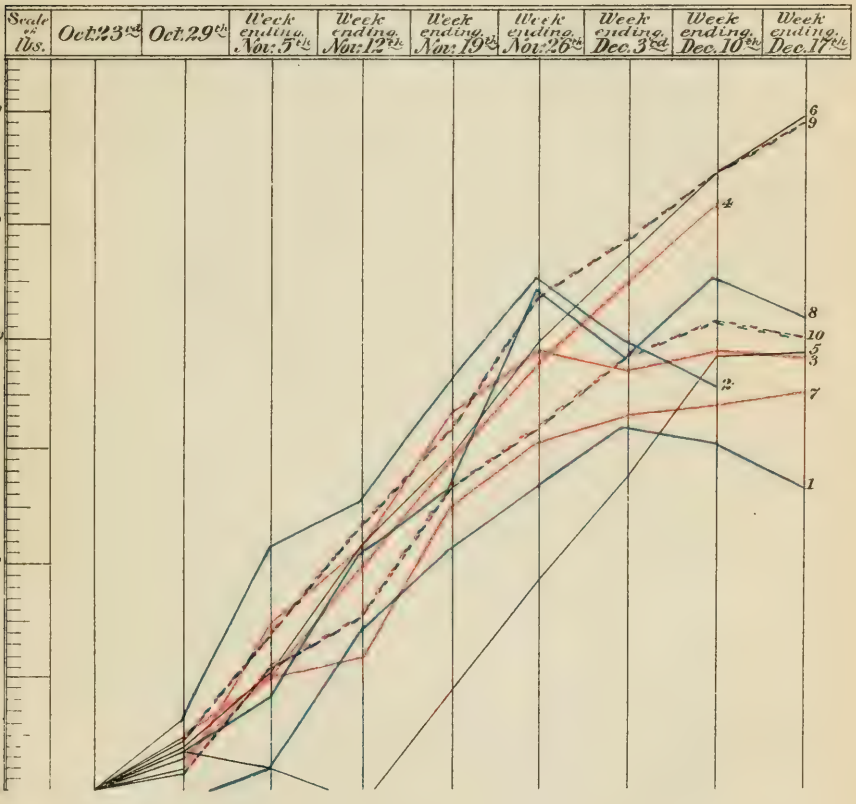


Diagram 3. Dry substance of feed consumed, per week, for each 100 lbs. of live weight.

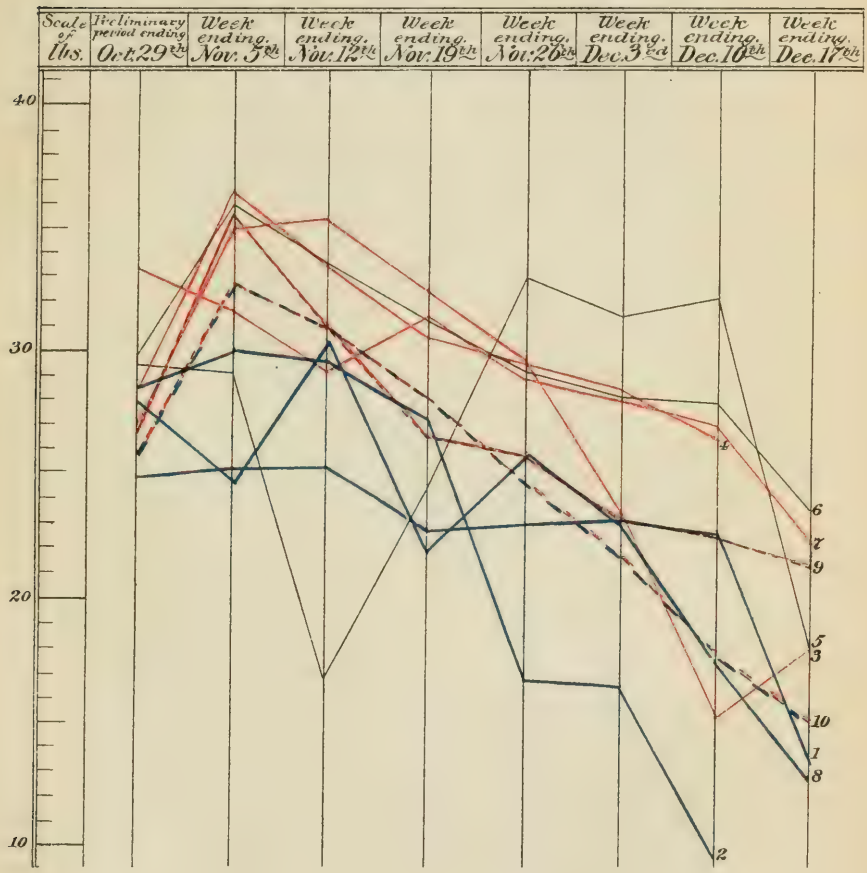
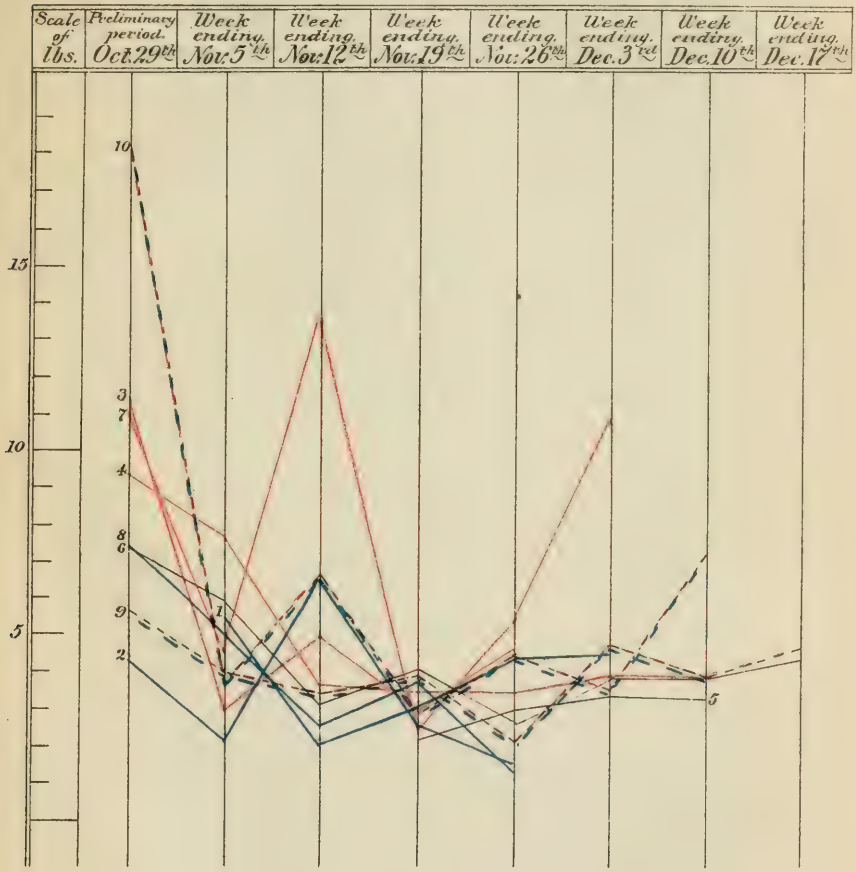


Diagram 4. *Dry substance, of feed consumed, required to produce 1 lb. of increase of live weight.*



A rheumatic affection of the hind legs of pig No. 2, accompanied with tenderness of the muscles and partial loss of motion, had been noticed for a few days at the close of the experiment, and he was not, therefore, weighed on the 17th.

The weather during the last week of the experiment was severe, the feed freezing in the troughs, and the thermometer, at times, nearly down to zero. Under these conditions, but two pigs (9 and 6) made a positive gain.

Pig No. 5 was sick, and lost weight the first two weeks of the experiment, which accounts for the low consumption of food recorded in table 2 and diagram 3, — during the next four weeks, however, with an exclusive diet of corn-meal, he made, on the whole, the best record, as will be seen by reference to table 5 and diagram 4.

The diagrams show that the feed required to produce a pound of increase in live weight varies from week to week, with the same food, and of the rations fed there is no particular one which seems to have an advantage, in this respect, over the others.

On the whole, the experiments fail to prove that corn-meal with bran or cotton-seed meal, or both, is a more valuable pig food than corn-meal alone.

HORTICULTURAL DEPARTMENT

OF

MASSACHUSETTS EXPERIMENT STATION.

To the Director and Board of Control.

GENTLEMEN : — The special work assigned to this department, and upon which I make the following report, is as follows : —

I. THE GROWTH AND CARE OF THE COLLECTION OF GRASSES AND FORAGE CROPS.

II. THE CARE OF THE FRUIT PLATS FOR DETERMINING THE EFFECT OF THE VARIOUS ELEMENTS OF PLANT-FOOD UPON THE COMPOSITION OF THE FRUIT.

III. TESTING THE VARIOUS KINDS OF NEW FRUITS.

IV. TO DETERMINE WHAT INFLUENCE THE STOCK MAY HAVE UPON THE SCION, IF ANY, IN GRAFTING.

V. STUDY OF DISEASES OF FRUIT AND OTHER TREES AND PLANTS, AND THE REMEDIES TO BE APPLIED.

VI. DESTRUCTION OF INJURIOUS INSECTS.

VII. GERMINATION OF SEEDS.

I.

Upon the land leased the Station by the College was found a collection of grasses and forage plants, consisting of the following species : —

Perennials.

Alopecurus pratensis,	Meadow foxtail.
Phleum pratense,	Timothy.
Dactylis glomerata,	Orchard grass.
Bromus secalinus,	Chess or cheat.
Bromus mollis,	Soft chess.
Bromus giganteus,	Great chess.
Lolium perenne,	Rye-grass.
Festuca elatior,	Meadow fescue.

Festuca ovina,	Sheep's fescue.
Festuca duriuscular,	
Festuca rubra,	Red fescue.
Festuca tenella,	Slender fescue.
Festuca gigantea,	Great fescue.
Agrostis vulgaris,	Red-top or Eng. bent.
Agrostis stolonifera,	Creeping bent.
Agrostis canina,	R. I. bent.
Poa pratense,	June-grass or Ky. blue-grass.
Poa trivialis,	Rough-stalked meadow.
Poa serotina,	False red-top.
Poa compressa,	Wire-grass.
Anthoxanthemum odoratum,	Sweet vernal.
Avena flavescens,	Yellow oat-grass.
Arrhenatherum avenaceum,	Wild oat-grass.
Aira cæspitosa,	Hair-grass.
Aira flexuosa,	Hair-grass.
Phalaris arundinacea,	Reed canary-grass.
Holcus lanatus,	Meadow soft-grass.
Calamagrostis Canadensis,	Blue-joint grass.

Annuals.

Phalaris Canariensis,	Canary-grass.
Solium Italicum,	Rye-grass.
Panicum Germanicum,	Hungarian millet.
Panicum Italicum,	Common millet.
Panicum miliaceum,	Golden millet.
Avena sativa,	Common oat.
Secale cereale,	Rye.
Triticum vulgare,	Wheat.
Hordeum vulgare,	Barley.
Sorghum vulgare,	Amber cane, Chinese, etc.

Leguminous.

Vicia sativa,	Vetch.
Lupinus perennis,	Blue lupine.
Lupinus luteus,	Yellow lupine.
Lupinus albus,	White lupine.
Trifolium pratense,	Red clover.
Trifolium hybridum,	Alsike clover.
Trifolium repens,	White clover.
Trifolium incarnatum,	Italian clover.
Mileletus albus,	Bokhara clover.
Lotus corniculatus,	Birdsfoot clover.
Medicage sativa,	Lucerne.
Ornithopus sativa,	Saradella.
Dolichos sinensis,	Cow-pea, var's "Whippoorwill and Clay."

The last mentioned was added to the collection this season.

The growth of the majority of the above has not been as good as could be desired, owing to the time they have been growing, — three or four years, — and many weeds have worked into the plats; so that, after gathering such specimens as were desired for analysis, they were ploughed under, and the collection will be increased as much as possible, and replanted early next spring.

The cow-peas and vetch were sown with oats and rye; but owing to the lateness of the season when the seed arrived, the growth was not sufficiently large to give a fair basis for determining their value.

II. Experimental Fruit Plats.

The trees and small fruits in these five plats have been under treatment for several years, and have yielded some fruit, which has been gathered for analysis.

The five plats into which the land was divided were planted with the same kinds of fruit in each; *i. e.*, apples, pears, peaches, plums, cherries, blackberries, raspberries, grapes, strawberries, currants and gooseberries, and is a good example of what may be done in close planting for a family fruit garden.

Four plats were fertilized with different elements of plant-food, and the fifth was left in its natural condition. The analyses of the fruit taken from these, made by Director Goessmann, and given in his previous reports, prove conclusively that the composition of fruits can be greatly affected by the application of special fertilizers.

The growth of the trees and plants has been very good; in fact, in some cases greater than is desirable for their most healthy development. This was especially the case with some of the peach trees, in which the growth of wood was so great and continued so late that it failed to mature, and the fruit buds were injured last winter, so that no fruit was borne the past season, while upon land less highly fertilized the trees produced large crops of fruit.

During the fall of 1881, and the winter of 1882, many of the trees in these plats were destroyed by cold, and all suf-

fered more or less, but no trace of the disease known as the *yellows* has made its appearance.

The soil upon which these trees are planted is a medium sandy loam, and well adapted to the growth of all kinds of fruits except the currant and quince.

III. Testing New Varieties of Fruits.

The soil to be devoted to this purpose is, like the above, well suited to the growth of all of the fruits except the currant and quince. The land has been prepared, and a few varieties of peach and apple trees planted.

IV. Influence of the Stock upon the Scion.

This experiment has only been started with some of the large fruits, but it is proposed to begin also with the smaller fruits and plants that require less time for development and maturity.

V. Diseases of Plants.

The time given to this subject has been largely in continuation of the study of the disease of the peach tree known as the *yellows*, which has for several years been carried on under the auspices of the college. In order to more fully understand the present condition of the experiment, I will give a brief history of the trees and the special treatment they have received.

The orchard originally consisted of about fifty trees, planted in 1870. For the first few years they received but little care. In the spring of 1873 all were carefully pruned to as good form as their condition would allow, the borers removed, and the soil manured and planted with squashes. The result was, that after a year or two they bore a good crop of fruit. After fruiting, many of the trees showed signs of disease, and a series of experiments were instituted with six or eight trees in 1878. The remarkable change made in these trees led to the continuance of the remedies upon all the peach trees in the college orchards that showed signs of disease. The results of the application of the remedies, when applied before the disease had made too great headway, have been entirely satisfactory; so much so

that most of the original trees are now in a healthy condition, although they have been thoroughly diseased, and the past season have borne as perfect fruit as is often produced by young trees.

Young trees have been planted where diseased trees were dug out, and the past season bore fruit. They are as healthy and vigorous as any trees in the orchard.

The remedies applied have been muriate of potash, from two to five pounds to the tree, sown in the fall or early spring, with ground bone or superphosphate, according to the condition of the soil, which, if very poor, should have an additional dressing of organic matter, like stable manure. In addition to these remedies, the borers (the larvæ of the moth, *Ægeria exitiosa*) have been dug out with a knife twice each year, — in June and August, — and the trees kept cut back to a close, compact form. The pruning is always done in the fall or winter, and the last season's growth is cut back one-half. In cases where the tree is weak and straggling in growth, many of the large, long branches are cut back to give it good form.

The results of all of our experiments with plant life lead us to the belief, although it may not now be susceptible of positive proof, that the fungus growth generally found in diseased plants only develops after the tissues have become deranged or injured by some external cause, as cold following a season of immature growth, exhaustion caused by overbearing or drought, exhaustion of the soil, or injuries from insects.

In every instance where proper remedies have been applied *in time*, the trees have recovered and made a good growth.

The chemical side of these experiments will be fully given by Dr. Goessmann.

The questions of *pear blight* and *rust* on the blackberry and raspberry have received attention, but the results are not fully complete, and will be reserved for a future report.

VI. Destruction of Injurious Insects.

The work in this line has been confined to means of destruction of the currant worm (*Eufitchia riberia*); the cab-

bage worm (*Pieris rapæ*); the plum weevil, or plum curculio (*Conotrachelus nenuphar*); the Colorado potato beetle (*Dophora decem-lineata*); and the rose bug (*Macrodactylus subspinosa*).

The various insecticides used were powdered hellebore, pyrethrum powder, carbolate of lime, lime and kerosene, and lime and sulphur. The above were used in the dry form and in liquid.

The Currant Worm.

This worm is the larva of a moth about three-fourths of an inch across, which destroys the foliage soon after it unfolds, and again about the time the fruit begins to ripen. It was destroyed very quickly by the hellebore and pyrethrum. The latter, being more rapid in its action, and entirely free from poisonous qualities, can be used without danger at any time. The results of application of the other insecticides were not satisfactory, and further experiment as to their value must be made at some future time.

The Cabbage Worm.

The only effectual and easily applied remedy found for this insect was the pyrethrum powder. This applied dry destroyed the worms very quickly, even when mixed with five times its bulk of common plaster. It was applied by means of a pair of common sulphur bellows with a curved nose, a single movement of the bellows being sufficient to send the dust over all parts of the inside of the plant. Insecticides applied in liquids did not prove satisfactory, on account of the peculiar structure of the surface of the leaves of the cabbage, which causes the liquid to roll off in drops. This remedy proved most effectual when extended with an equal bulk of plaster.

Curculio, or Plum Weevil.

All the remedies applied for the destruction of this pest were ineffectual in saving a single specimen of fruit from some twenty trees that bloomed and set a large crop.

It is hoped, however, that by further experiments with the same remedies and other substances something may be found that will save this crop, either by being offensive to or by the destruction of the insects. In the meantime the certain but laborious method of jarring the trees and destroying the insects and the fruit containing their larvæ, or that of planting the trees in poultry yards, must be resorted to.

The Potato Beetle.

The effect of the pyrethrum powder on the larvæ of this beetle was to paralyze for a time, but not to kill them.

The Rose Bug.

This is another insect that our remedies, in a measure, failed to destroy or to prevent wholly from destroying the grape crop and rose blossoms. Pyrethrum has the effect of paralyzing them for a time, and by repeated applications, several times each day, may prove effectual.

Kerosene and lime, dry, seemed offensive to them, but they returned in a short time. Further experiments are required to fully determine its value.

In the use of carbolic acid, kerosene, and sulphur, they were slacked with caustic lime and applied in form of powder or in liquids.

The liquids used for the distribution of insecticides were water and buttermilk; the latter causing the substances to adhere to the foliage for a long time; in some cases three weeks or more.

An examination was made to determine the cause of the dropping of the apple crop, and it was found, in eight hundred specimens examined when from one-half of an inch to one inch in diameter, that all but three of this number were punctured, and contained one or more eggs or larvæ of the plum weevil, and only a very few contained the larvæ of the codling moth, which is so destructive later in the season.

VII. Germination of Weed Seeds.

Material for these experiments was collected during the summer and autumn, and arrangements are already made for

testing the germinating power of various kinds of seeds, especially troublesome weed seeds, at different stages of ripeness, and also under various conditions, the report of which will be made for one of the early monthly bulletins.

S. T. MAYNARD,

Professor of Botany and Horticulture,
Massachusetts Agricultural College.

ANNUAL REPORT OF THE CHEMIST.

I. Fodder and Fodder Analyses.

To ascertain the composition of our fodder articles, as far as the character and relative proportion of their essential proximate constituents are concerned, is the first step towards the introduction of a rational system of feeding our farm live stock.

A better knowledge of what we feed enables us to give a more judicious explanation of the results of our feeding experiments; it teaches best how to supplement our own fodder resources to meet the special wants of our farm stock, and cannot fail to direct the attention of the producer of fodder crops to the important question whether they are, as far as quality is concerned, what they ought to be. Actual feeding experiments have shown that the condition and quality of the soil exert a decided influence, not only on the quantity, but also on the quality of the crops raised upon it. For instance, oats raised during the same season upon the same kind of soil, with the aid of manures and without them, have been noticed to contain in the latter case as low as five, and in the former as high as eleven, per cent. of nitrogenous constituents in its dry vegetable matter.

The existence of similar relations between the particular condition of the soil and the composition of the crops, has been proved in regard to most of our prominent grasses and leguminous plants, as clover, as well as of mixed forage crops, like meadow hay.

A high percentage of nitrogenous constituents in these crops is usually accompanied by a high percentage of phosphoric acid compounds.

As both are known to exert a decidedly beneficial influence on the absolute and relative nutritive value of a single article of fodder, may it be an entire plant, or a particular part of it, it needs scarcely any farther argument to prove that an economical system of feeding our farm stock ought to begin with an intelligent cultivation of our leading fodder crops. We ought to raise them with a view to promote the special development of their most valuable nutritive constituents; and to select the crops for cultivation with reference to the particular adaptation of soil, climate and location *to favor the production of the best of its kind.* The introduction of a greater variety of fodder crops cannot fail to assist materially in gaining the desirable end. To raise good potatoes for family use, or good sugar-beets for the sugar manufacturer, requires a different condition of the soil, as far as the character of its accumulated plant-food is concerned, than to raise both crops of a superior quality for feeding purposes.

A mealy potato is usually rich in starch and, comparatively speaking, deficient in nitrogenous matter; and sugar-beets, best adapted for the manufacture of sugar, are rich in sugar, and contain a low percentage of nitrogenous constituents; they yield to the manufacturer the largest amount of sugar at the lowest expense.

The garden-farmer and manufacturer of sugar judge the quality of their respective crops by a standard quite different from that of the farmer who, engaged in general farming, considers stock-feeding an important part of his industry.

To compound an economical and suitable diet for any class of farm animals requires not only a general knowledge of the composition of the fodder on hand, but also a fair acquaintance with the relative proportion of the three groups of essential nutritive constituents they are apt to contain under different conditions of the soil. This kind of information is as essential for the guidance of the experimenter as the knowledge of the special wants of the animal with reference to its organization, age and functions. The wide range of variations in composition which has been noticed in our leading fodder crops when raised upon rich or ex-

hausted lands, renders many of our current tabular statements of the chemical composition of the more prominent articles of fodder of *doubtful merit in the hands of the farmer, who considers them an unfailing guide in his special case.*

The majority of these fodder tables may be traced to one source (E. Wolff). They state the mean of a smaller or larger number of analyses, quite frequently made without any intention to ascertain the possible variations in the composition of the article under investigation. The analytical statements themselves refer in the majority of cases to plants raised in Germany, and in other European countries. Whilst the great value of these Tables from an agricultural educational standpoint must be conceded, their analytical statements require qualification before they may be safely relied on in home practice. The Annual Report of the Secretary of the Massachusetts State Board of Agriculture for 1882, pages 104–114, contains a tabular statement of the composition of many fodder crops, giving the extremes (highest and lowest percentages found), with reference to each group of nutritive constituents. (Julius Kühn.)

This mode of stating the composition of the various farm crops tends to direct the attention more decidedly towards the advantages arising from a proper cultivation of fodder crops.

The Experiment Station has entered upon a systematic course of investigation to assist in determining the influence of stage of growth and of cultivation on the feeding value of some of our prominent forage plants.

The chemical analysis of any article of fodder begins usually with the determination of its moisture, and of the amount of *dry matter* left behind when heated to a temperature not exceeding 110° C., or 230° F., until a constant weight is obtained. The proximate constituents of the dry matter are subsequently reported with reference to the special relation they bear towards the support of animial life. Liebig's classification of the constituents of a complete animal food into *three distinct nutritive groups* of *compounds*, namely, nitrogen containing organic substances (*nitrogenous substances, crude protein*), non-nitrogenous, containing organic sub-

stances (carbo-hydrates) and mineral matter, is still recognized in the general arrangement of the analytical results of the examination. As more recent investigations have shown a superior physiological value of the fat,* — one of the non-nitrogenous constituents, — as compared with starch, sugar, and other representatives of that group, its amount is separately recorded. The same course, for similar reasons, has been of late adopted with reference to certain soluble forms of nitrogenous organic constituents of fodder articles.

In the subsequent analytical statements of examinations carried on at the Station, crude fat refers to the non-volatile residue of the ether abstract of the dried material; and crude protein refers to the nitrogen obtained by the soda lime test, multiplied by 6.25. The substances were in every case reduced to a uniform size, by passing them through a metal sieve, 144 mesh to the square inch.

The general course of analysis was the customary one, introduced by Henneberg and Stohman. Each analysis, as far as possible, is accompanied with a statement of the ratio of digestibility of the various groups of fodder constituents, ascertained in some well-conducted feeding experiments.

Records of this kind cannot fail to assist in forming a more intelligent opinion regarding the real nutritive portion of the fodder we feed.

* See, for details, "Influence of Chemistry on a Rational System of Stock Feeding," in the Thirtieth Annual Report of the Massachusetts State Board of Agriculture (1882-83), pages 89 to 125.

II. Analyses of Fodder.

DRIED FODDER CORN — (Frost-Bitten).

[From the Farm of the Experiment Station, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	8.83	176.6	–	–	
Dry Matter,	91.17	1,823.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	4.86	92.7	–	–	
" Cellulose,	29.05	581.0	418.32	72	1 : 9.82
" Fat,	2.06	41.2	30.90	75	
" Protein (Nitrogenous Matter),	8.63	172.6	126.00	73	
Non-nitrogenous Extract Matter,	55.40	1,108.0	742.36	67	
	100 00	2,000.0	1,317.58	–	

The sample was taken from unmanured fields, September 5, 1883, after a serious frost. The material for analysis was dried by artificial means. The bulk of the crop was put into a silo. The corn showed only the tassel, no silk having yet appeared. It was turned into ensilage at an earlier stage of growth than was originally intended. The dry matter contained in fodder corn, between showing the tassel and maturing the kernel, may vary from 12 to 18 per cent. and more.

CORN STOVER — (FROST-BITTEN).

[From Unmanured, Underdrained Plats of the Station.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C., . .	8.73	174.6	–	–	
Dry Matter, ...	91.27	1,825.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	3.12	62.4	–	–	
" Cellulose, . . .	34.28	685.6	356.51	52	
" Fat, ...	1.27	25.4	7.11	28	
" Protein (Nitrogenous Matter), . . .	6.58	131.6	48.69	37	1 : 16.67
Non-nitrogenous Extract Matter, ...	54.75	1,095.0	438.00	40	
	100.00	2,000.0	850.31	–	

The kernels were not fully matured in consequence of the frost.

FODDER CORN (1).

[Sent by THOMAS J. FIELD, Northfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C., . .	6.65	133.0	–	Not determined by actual feeding experiment.	–
Dry Matter, ...	93.35	1,867.0	–		–
	100.00	2,000.0	–		–
Analysis of Dry Matter.					
Crude Ash, ...	4.68	93.6	–		–
" Cellulose, . . .	31.39	627.8	–		–
" Fat, ...	1.42	28.4	–		–
" Protein (Nitrogenous Matter), . . .	6 83	136.6	–		–
Non-nitrogenous Extract Matter,	55.68	1,113.6	–		–
	100.00	2,000.0	–		–

FODDER CORN (2).—(Frost-bitten.)

[Sent by Thomas J. Field, Northfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	6.67	133.4	–	–	–
Dry Matter,	93.33	1,866.6	–	–	–
	100.00	2,000.0	–	–	–
Analysis of Dry Matter.					
Crude Ash,	5.11	102.2	–	–	–
" Cellulose,	33.75	675.0	–	–	–
" Fat,	1.11	22.2	–	–	–
" Protein (Nitrogenous Matter),	6.17	123.4	–	–	–
Non-nitrogenous Extract Matter,	53.86	1,077.2	–	–	–
	100.00	2,000.0	–	–	–

The history of the above two samples of fodder corn, as far as their respective stages of growth and their mode of cultivation, etc., is concerned, has not been reported.

The analytical results show some difference in composition in favor of No. 1, yet hardly enough, under existing circumstances, to encourage a discussion of the effects of frost in this particular case. The sample of frost-bitten corn, after careful drying, proves still of a fair composition. The particular stage of growth and the character of the weather exert a controlling influence on the degree of changes in composition.

The effects of frost are usually more serious in the earlier periods of the life of the plants than in their more matured states. Dry, cool weather, after a frost, causes less alteration in composition than sultry, warm weather. Frost-bitten green fodder corn is best preserved in silos.

CORN-MEAL.

[Collected of Chas. Parsons, Northampton, Mass.]

93.25 parts passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	17.04	340.80	–	–	
Dry Matter,	82.96	1,659.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	1 58	31.60	–	–	
" Cellulose,	3.60	72.00	24.48	34	
" Fat,	4.82	96.40	73.26	76	1 : 5.54
" Protein (Nitrogenous Matter),	16.80	336.00	285.60	85	
Non-nitrogenous Extract Matter,	73.20	1,464.00	1,376.16	94	
	100.00	2,000.00	1,759.50	–	

Essential Mineral Constituents in 100 Parts of Corn-meal.

Potassium oxide,	0.419
Calcium oxide,	0.040
Magnesium oxide,	0.176
Phosphoric acid,	0.644

The above rate of digestibility was found in feeding experiments with pigs.

CORN-MEAL.

[From JOHN L. HOLLEY, South Amherst, Mass.]

Ninety-two per cent. passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	13.55	271.0	–	–	
Dry Matter,	86.45	1,729.0	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	1.42	28.4	–	–	
" Cellulose,	2.64	52.8	17.95	34	1 : 9.66
" Fat,	4.24	84.8	64.45	76	
" Protein (Nitrogenous Matter),	10.40	208.0	176.80	85	
Non-nitrogenous Extract Matter,	81.30	1,626.0	1,528.44	94	
	100.00	2,000.0	1,787.64	–	

The article is a fair specimen of its kind. As a more detailed discussion of the composition of corn may not be without some interest in this connection, I refer to the results of an examination of eleven prominent Eastern, Western, and Southern varieties, which have been published in the annual report of the Massachusetts State Board of Agriculture for 1879. The samples of corn which served for my investigation were furnished by well-known parties. The mode of cultivation and of manuring was stated, and the material had been collected with care. The analytical work was carried on with a view of securing results of a strictly comparative value. They were stated with reference to a corresponding amount of moisture, to render differences in composition prominent at sight. The actual demonstration of the influence of the particular condition of the soil on the feeding value of the same variety of corn raised upon it (independent of varying quantity) deserves a serious consideration.

CORN-MEAL AND COBS.

[Collected of CHAS. PARSONS, Northampton, Mass.]

78.63 per cent. passed through mesh of 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	19.07	381.40	–	Not determined by actual feeding experiment.	–
Dry Matter,	80.93	1,618.60	–		–
	100.00	2,000.00	–		–
Analysis of Dry Matter.					
Crude Ash,	1.61	32.20	–		–
" Cellulose,	9.77	195.40	–		–
" Fat,	3.43	68.60	–		–
" Protein (Nitrogenous Matter),	15.06	301.20	–		–
Non-nitrogenous Extract Matter,	70.13	1,402.60	–		–
	100.00	2,000.00	–		–

The rate of digestibility of corn cobs has been stated of late by E. Wolff as follows: 42 per cent. of protein, 52 per cent. of non-nitrogenous matter, and 30 per cent. of the fat. Whether these values are the results of actual feeding experiments, or an approximation by this distinguished author, I am not prepared to decide. There is but little doubt, however, that the addition of cobs to meal deserves recognition in regard to their nutritive value as well as to their beneficial mechanical influence upon the digestion of the corn-meal. For analysis of corn cobs, see report of Mass. Board of Agriculture for 1879, pages 240–244.

NEBRASKA RED CORN.

[Sent from Franklin County, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C., . .	10.74	214.8	–	–	
Dry Matter, ...	89.26	1,785.2	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	1.44	28.8	–	–	
" Cellulose, . . .	3.36	67.2	22.85	34	1 : 6.97
" Fat, ...	6.05	121.0	91.96	76	
" Protein (Nitrogenous Matter), . .	14.16	283.2	240.72	85	
Non-nitrogenous Extract Matter, ...	74.99	1,499.8	1,424.81	95	
	100.00	2,000.0	1,780.34	–	

A comparison of the above stated analytical results, with those previously referred to, show a high nutritive value for the red variety. Whether this result is mainly due to a high state of fertilization of the soil which served for its production, or to an inherent superiority of this variety of corn, further observation can only decide.

HOMINY FEED.

[Chit and Soft Parts of the Kernel of the Corn, collected of J. A. SULLIVAN, Northampton, Mass.]

46.07 per cent. passed through mesh, 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	8.93	178.60	–	Not determined by feeding experiment.	–
Dry Matter,	91.07	1,821.40	–		–
	100.00	2,000.00	–		–
Analysis of Dry Matter.					
Crude Ash,	2.07	41.40	–		–
" Cellulose,	3.77	75.40	–		–
" Fat,	4.89	97.80	–		
" Protein (Nitrogenous Matter,	11.20	224.00	–		
Non-Nitrogenous Extract Matter,	78.07	1,561.40	–		–
	100.00	2,000.00	–		–

Essential Mineral Constituents in 100 parts of Hominy Feed.

Potassium oxide,	0.49 per cent.
Calcium oxide,	0.18 "
Magnesium oxide,	0.28 "
Phosphoric acid,	0.98 "

The rate of digestibility is probably similar to that of corn-meal.

GLUTEN MEAL (1).

[Refuse from Glucose Manufacture from Messrs. SUMNER CROSBY & SON, South Boston, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	8.43	168.6	–	Not ascertained by actual experiment.	–
Dry Matter,	91.57	1,831.4	–		–
	100.00	2,000.0	–		–
Analysis of Dry Matter.					
Crude Ash,	.64	12.8	–		–
" Cellulose,	3.55	71.0	–		–
" Fat,	8.75	175.0	–		–
" Protein (Nitrogenous Matter,	38.22	764.4	–		–
Non-Nitrogenous Extract Matter,	48.84	976.8	–		–
	100.00	2,000.0	–		–

Essential Mineral Constituents in 100 parts of Gluten Meal.

Potassium oxide,	0.0564
Calcium oxide,	0.0582
Magnesium oxide,	0.0346
Phosphoric acid,	0.4512
Sulphuric acid,	0.0215

GLUTEN MEAL (2).

[Refuse from Glucose Manufacture sent by NEWTON & FULLER, Springfield, Mass.]

Eighty-three per cent. passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	10.23	204.6	–	Not determined by actual experiment.	–
Dry Matter,	89.77	1,795.4	–		–
	100.00	2,000.0	–		–
Analysis of Dry Matter.					
Crude Ash,	.65	13.0	–		–
" Cellulose,	1.20	24.0	–		–
" Fat,	5.06	101.0	–		–
" Protein (Nitrogenous Matter,	33.56	671.4	–		–
Non-nitrogenous Extract Matter,	59.53	1,190.6	–		–
	100.00	2,000.0	–		–

Both articles were of a good mechanical condition. A comparison of the first and second analysis shows that the latter contained 3 per cent. of fat and 5 per cent. of nitrogenous matter less than the former, whilst its soluble non-nitrogenous constituents exceed that of the former about 10 per cent. No free sulphuric acid was noticed in either case. The rich nitrogenous character of the "gluten meal" places it between the brans of our grains and the oil cakes, and alongside of our leguminous seeds, as beans, pease, etc. Its peculiarity, as compared with the above fodder articles, consists in the low percentage of mineral constituents, a point which requires a careful consideration in its application. It ought to be fed with coarse articles of fodder, rich in mineral matter.

HAY OF BLACK GRASS (1).

[The following six samples of hay were sent by the Secretary of the Rowley Farmers' Club, Rowley, Essex County, Mass., in April, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	10.22	204.40	–	Not ascertained by actual feeding experiment.	–
Dry Matter,	89.78	1,795.60	–		–
	100.00	2,000.00	–		–
Analysis of Dry Matter.					
Crude Ash,	8.63	172.6	–		–
" Cellulose,	24.78	495.6	–		–
" Fat,	1.52	30.4	–		–
" Protein (Nitrogenous Matter),	9.39	187.8	–		–
Non-nitrogenous Extract Matter,	55.68	1,113.6	–		–
	100.00	2,000.0	–		–

The grass was cut before blooming on the 24th of June, 1882; it would have matured, according to the letter of the secretary, by the 10th of July. The hay had been housed as soon as cured.

HAY OF BLACK GRASS (2).

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	13.15	263.0	–	Not ascertained by actual feeding experiment.	–
Dry Matter,	86.85	1,737.0	–		–
	100.00	2,000.0	–		–
Analysis of Dry Matter.					
Crude Ash,	6.50	130.0	–		–
" Cellulose,	23.66	573.2	–		–
" Fat,	1.20	24.0	–		–
" Protein (Nitrogenous Matter,	7.15	143.0	–		–
Non-nitrogenous Extract Matter,	61.49	1,129.8	–		–
	100.00	2,000.0	–		–

The grass which served for the production of hay No. 2 was cut when it began to look red, — approaching maturity, — July 24th, 1882, and was housed as soon as cured.

HAY OF HIGH MARSH GRASS (3).

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	11.05	221 0	–	–	–
Dry Matter,	88.95	1,779.0	–	–	–
	100.00	2,000.0	–	–	–
Analysis of Dry Matter.					
Crude Ash,	6.18	123.6	–	–	–
" Cellulose,	24.81	496.2	–	–	–
" Fat,	0.98	19.6	–	–	–
" Protein (Nitrogenous Matter),	6.14	122.8	–	–	–
Non-nitrogenous Extract Matter,	61.89	1,237.8	–	–	–
	100.00	2,000.0	–	–	–

The grass was cut in July, 1882, and stored when cured. No statement was made with reference to the particular stage of growth of the grass at the time of cutting.

HAY OF LOW MARSH GRASS (4).

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	10.97	219.4	–	Not ascertained by actual feeding experiment.	–
Dry Matter,	89.03	1,780.6	–		–
	100.00	2,000.0	–		–
Analysis of Dry Matter.					
Crude Ash,	8.19	163.8	–		–
" Cellulose,	28.82	576 4	–		–
" Fat,	2.22	44.4	–		–
" Protein (Nitrogenous Matter),	6.79	135.8	–		–
Non-nitrogenous Extract Matter,	53.98	1,079.6	–		–
	100.00	2,000.0	–		–

The grass was cut in August, 1882, and stacked as soon as cured.

HAY OF LOW MARSH GRASS (5).

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	er Cent. of Digestibil ty o Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.25	205.0	–	Not ascertained by actual feeding experiment.	–
Dry Matter,	89.75	1,795.0	–		–
	100.00	2,000.0	–		–
Analysis of Dry Matter.					
Crude Ash,	5.42	108.4	–		–
" Cellulose,	26.00	520.0	–		–
" Fat,	2.63	52.6	–		–
" Protein (Nitrogenous Matter),	7.19	143.8	–		–
Non-nitrogenous Extract Matter,	58.76	1,175.2	–		–
	100.00	2,000.0	–		–

The grass was cut in the middle of August, and housed as soon as cured.

HAY OF LOW MARSH GRASS (6).

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	13.30	266.0	–	Not ascertained by actual feeding experiment.	–
Dry Matter,	86.70	1,734.0	–		–
	100.00	2,000.0	–		–
Analysis of Dry Matter.					
Crude Ash,	6.05	121.0	–		–
" Cellulose,	27.19	543.8	–		–
" Fat,	2.90	58.0	–		–
" Protein (Nitrogenous Matter),	7.17	143.4	–		–
Non-nitrogenous Extract Matter,	56.69	1,133.8	–		–
	100.00	2,000.0	–		–

The grass was cut September 9th, and stacked when cured. It was injured somewhat by rain, and by the sea water.

Analysis of Dry Matter of the Hays sent on by the Rowley Farmers' Club, and of an Average Quality of good Inland Meadow Hay.

	Hay of Black Grass, No. One.	Hay of Black Grass, No. Two.	Hay of High Marsh Grass, No. Three.	Hay of Low Marsh Grass, No. Four.	Hay of Low Marsh Grass, No. Five.	Hay of Low Marsh Grass, No. Six.	Hay of genuine Grasses in Full Blossom (H. Weiske).
Crude Ash,	8.63	6.50	6.18	8.19	5.42	6.05	8.55
" Cellulose,	24.78	23.66	24.81	28.82	26.00	27.19	27.61
" Fat,	1.52	1.20	0 98	2.22	2.63	2.90	5.02
" Protein (Nitrogenous Matter),	9.39	7.15	6.14	6.79	7.19	7 17	12.69
Non-nitrogenous Extract Matter,	55.68	61.49	61.89	53.98	58.76	56.69	46.13
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

The various samples of marsh or "salt hay," which served for the above analyses, were supplied by different members of the club; they arrived in good condition, and had evidently been collected with care. The individual plants, however, were in a condition which did not allow a satisfactory determination of their botanical names, and of the relative proportion of the various kinds of plants present, nor of their particular stage of growth. The communication received from the secretary of the club has to furnish, for this reason, the basis for a few subsequent remarks. A small collection of the upper portion of marsh meadow plants, neatly fastened upon suitable paper, accompanied the hay samples. To each specimen of this collection was attached its local name, with some general remarks as follows: —

"No. 1, — Sedge grass, grows on low spots.
"No. 2, — Branch grass.
"No. 3, — Goose grass, stalks with seeds.
"No. 4, — Fox, or red grass, the most common salt grass.
"No. 5, — Marsh mallows, called by some rosemary.
"These varieties of plants are generally found more or less mixed in all salt marshes. On marshes that have been ditched, a grass called white-top — by some called red-top — comes in and grows together with the above-stated fox grass. This white-top is nearly as early as 'black grass,' which is one of our earliest grasses, and the only one which grows distinct by itself."

As grass, like "rushes" and "sedges," exerts a controlling influence on the local character, and thus the comparative feeding value of the hay obtained from different places, it has to be conceded that the absence of a more detailed information regarding the particular character and condition of the vegetation, etc., which served for the production of the above-described hay samples, imparts to our analytical results in the majority of cases (from three to six) a mere local interest. A comparison of the various samples seems to confirm the prevailing impression that the "black grass" (*Juncus bulbosus*) furnishes a valuable fodder; and that

carefully secured marsh hay in many instances, as far as composition is concerned, compares favorably with a large proportion of hay from "inland" meadows. There is scarcely another fodder crop on record of which the feeding value depends so much on a judicious management of the farmer as in the case of hay.

The first requirement for an intelligent examination concerning the comparative value of a fodder plant, or part of a plant, consists in securing specimens of a corresponding stage of growth. Adding to this a due consideration of the various circumstances under which the plants under examination are raised, results are attainable which may claim a general interest.

I take the liberty of suggesting, in this connection, to communicate rather with the officer in charge of the Station, before sending material of a similar character, and of asking an investigation of a subject of similar importance. The best interest of the farmers and of the Station will be served by adopting that course.

The fact that our opinion regarding the actual and relative feeding value of many of our fodder crops is still largely based on mere chance analyses, instead of on a systematic inquiry regarding our chances of securing the best results, is one of the principal impediments of arriving at a more settled opinion regarding a more rational management of feeding our farm live stock.

HAY OF WINTER RYE.

[Sent by JOHN E. RUSSELL, Secretary of Massachusetts Board of Agriculture.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	8.55	171.0	–	–	
Dry Matter,	91.45	1,829.0	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.40	128.0	–	–	
" Cellulose,	32.97	659.4	–	–	
" Fat,	2.57	51.4	23.65	46	1 : 8.28
" Protein (Nitrogenous Matter),	10.66	213.2	121.52	57	
Non-nitrogenous Extract Matter,	47.40	948.0	948.00	100	
	100.00	2,000.0	1,093.17	–	

The sample was cut May 25, 1883, when in full blossom. It is of a fair quality, and compares well with a medium good quality of meadow hay. The ratio of digestibility stated in connection with the non-nitrogenous extract matter of the hay, includes that of the crude cellulose, or raw fibre.

Green winter rye in blossom may contain from 20 to 26 per cent. of vegetable matter, and from 80 to 74 per cent. of water.

TIMOTHY HAY.

[From the Experimental Farm.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C., . .	8.70	174.0	–	–	–
Dry Matter, ...	91.30	1,826.0	–	–	–
	100.00	2,000.0	–	–	–
Analysis of Dry Matter.					
Crude Ash, ...	4.04	80.8	–	–	–
" Cellulose, . . .	36.59	731.8	–	–	–
" Fat, ...	2.12	42.4	–	–	–
" Protein (Nitrogenous Matter), . . .	7.24	144.8	–	–	–
Non-nitrogenous Extract Matter, ...	50 01	1,000.2	–	–	–
	100.00	2,000.0	–	–	–

The hay was harvested in July, after blooming. The sample was taken from the barn in November.

HAY OF RIPE OATS.

[From the Experimental Farm.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C., . .	8.70	174.0	–	–	–
Dry Matter, ...	91.30	1,826.0	–	–	–
	100.00	2,000.0	–	–	–
Anatysis of Dry Matter.					
Crude Ash, ...	6.11	122.2	–	–	–
" Cellulose, . . .	36.31	726.2	–	–	–
" Fat, ...	2.61	52.2	–	–	–
" Protein (Nitrogenous Matter), . . .	6.05	121.0	–	–	–
Non-nitrogenous Extract Matter, ...	48.92	978.4	–	–	–
	100.00	2,000.0	–	–	–

The material for analysis consisted of the entire matured plant, and was collected August 26, 1883.

HAY OF OATS.

[From one of the Experimental Plats of the Station.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C., . .	6.43	128.6	–	–	
Dry Matter, ...	93.57	1,871.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	6.41	128.2	–	–	
" Cellulose, . . .	34.06	681.2	–	–	
" Fat, ...	2.92	58.4	26.86	46	1 : 14.24
" Protein (Nitrogenous Matter), . . .	6.58	131.6	75.01	57	
Non-nitrogenous Extract Matter, ...	50.03	1,000.6	1,000.60	100	
	100.00	2,000.0	1,102.47	–	

The sample was collected August 1, 1883, when in full blossom. It contained 74 per cent. of moisture, and 26 per cent. of dry matter. Its composition as shown by analysis can scarcely be called a fair one. The dry matter of oats in blossom may vary from 15 to 26 per cent.

Actual feeding experiments have shown that the condition and quality of the soil, aside from season and climate, exert a decided influence not only on the quantity, but also upon the quality of the crops raised upon it.

The analyses of our rye, oats and timothy previously described, were made with a view to ascertain the condition of the land which has passed under the control of the Station.

RYE BRAN.

[Collected of CHAS. PARSONS, Northampton, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C., . .	13.70	274.00	–	–	
Dry Matter, ...	86.30	1,726.00	–	–	
	100.00	2,000.00	–	–	
Analyis of Dry Matter.					
Crude Ash, ...	5.17	103.40	–	–	
" Cellulose, . . .	4.54	90.80	8.17	9.	1 : 4.39
" Fat, ...	2.07	41.40	23.80	57.5	
" Protein (Nitrogenous Matter), . . .	18.98	379.60	250.54	66.	
Non-nitrogenous Extract Matter, ...	69.24	1,384.80	1,031.68	74.5	
	100.00	2,000.00	1,314.19	–	

The above ratio of digestibility of the various constituents was ascertained in feeding experiments with pigs.

WHEAT BRAN.

[Collected of CHAS. PARSONS, Northampton, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C., . .	13.70	274.00	–	–	
Dry Matter, ...	86.30	1,726.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	6.76	135.20	–	–	
" Cellulose, . . .	9.33	186.60	37.32	20	1 : 3.30
" Fat, ...	2.91	58.20	46.56	80	
" Protein (Nitrogenons Matter), . . .	19.56	391.20	344.26	88	
Non-nitrogenous Extract Matter, ...	61.44	1,228.80	983.04	80	
	100.00	2,000.00	1,411.18	–	

The above rate of digestibility was ascertained by feeding the dry material to steers.

WHEAT BRAN.

[From JOHN L. HOLLEY, South Amherst, Mass.]

Thirty-three per cent. passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	12.08	241.6	–	–	
Dry Matter,	87.92	1,758.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.92	158.4	–	–	
" Cellulose,	13.72	274.4	54.88	20	1 : 4.16.
" Fat,	3.81	76.2	60.96	80	
" Protein (Nitrogenous Matter),	15.67	313.4	275.79	88	
Non-nitrogenous Extract Matter,	58.88	1,177.6	942.08	80	
	100.00	2,000.0	–	–	

The article is of a fair composition.

LINSEED CAKE.

[From Indiana.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	8.35	167.00	–	–	
Dry Matter,	91.65	1,833.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.52	150.40	–	–	
" Cellulose,	8.69	173.80	45.19	26	1 : 1.62
" Fat,	5.69	113.80	103.56	91	
" Protein (Nitrogenous Matter),	37.25	745.00	648.15	87	
Non-nitrogenous Extract Matter,	40.85	817.00	743.47	91	
	100.00	2,000.00	1,540.37	–	

Essential Mineral Constituents in 100 parts Linseed Cake.

Potassium oxide,	1.43 per cent.
Calcium oxide,	0.64 "
Magnesium oxide,	0.77 "
Phosphoric acid,	1.86 "

The stated ratio of digestibility was ascertained by feeding experiments with steers.

COTTON-SEED MEAL.

[Collected of CHARLES PARSONS, Northampton, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	9.13	182.60	–	–	
Dry Matter,	90.87	1,817.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.61	152.20	–	–	
" Cellulose,	6.28	125.60	28.89	23	1 : 1.23
" Fat,	12.83	256.60	233.51	91	
" Protein (Nitrogenous Matter),	47.04	940.80	696.19	74	
Non-nitrogenous Extract Matter,	26.24	524.80	241.41	46	
	100.00	2,000.00	1,200.00	–	

The percentage of nitrogenous constituents is exceptionally high.

The above rate of digestibility is based on experiments with sheep.

COTTON-SEED MEAL.

[From JOHN L. HOLLEY, South Amherst, Mass.]

Eighty-nine per cent. passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	8.38	167.6	–	–	
Dry Matter,	91.62	1,832.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	8.51	170.2	–	–	
" Cellulose,	6.73	134.6	30.82	23	
" Fat,	12.94	258.8	235 51	91	1 : 1.41
" Protein (Nitrogenous Matter),	42.47	849.4	628.56	74	
Non-nitrogenous Extract Matter,	29.35	587.0	270.02	46	
	100.00	2,000.50	1,164.91		

A very good article as far as composition and mechanical conditions are concerned.

COTTON-SEED MEAL (1).

[Sent by J. E. SOPER & Co., Boston.]

Eighty-six per cent. passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	7.10	142.0	–	–	
Dry Matter,	92.90	1,858 0	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	9.34	186.8	–	–	
" Cellulose,	7.53	150 6	34.63	23	
" Fat,	13.75	275.0	250.25	91	1 : 1.44
" Protein (Nitrogenous Matter),	42.58	851.6	630.18	74	
Non-nitrogenous Extract Matter,	26.80	536.0	246.56	46	
	100.00	2,000.0	1,161.62	–	

The composition of the above article does not materially differ from previous analyses; the variations are within the limits noticed in fair samples of cotton-seed meal. Its mechanical condition was of a superior character. The meal was produced, according to the statement of the dealer, by a new process, "Roller-Process," and sifted.

COTTON-SEED MEAL (2).

[Sent by J. E. SOPER & Co., Boston.]

Eighty-one per cent. passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	8.15	163.0	–	–	
Dry Matter,	91.85	1,837.0	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.46	149.2	–	–	
" Cellulose,	7.41	148.2	34.09	23	1 : 1.88
" Fat,	14.72	294.4	267.90	91	
" Protein (Nitrogenous Matter),	36.54	730.8	540.79	74	
Non-nitrogenous Extract Matter,	33.87	677.4	311.60	46	
	100.00	2,000.0	1,154.38	–	

The article was obtained by the old (press) process. The sample which served for analysis (1) was of a better mechanical condition than (2). A comparison of samples (1) and (2) show their difference, due rather to the fact that different lots of cotton-seed served for the production of the article tested, than to a different process of grinding. The two modes of producing cotton-seed meal ought to be tried on the same lot of seeds, to render their respective merits conspicuous.

COTTON-SEED MEAL.

[Sent by E. S. WARNER, Hatfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	7.09	141.8	–	–	
Dry Matter,	92.91	1,858.2	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	9.15	183.0	–	–	
" Cellulose,	10.53	210.6	48.44	23	1 : 1.46
" Fat,	13.65	273.0	248.43	91	
" Protein (Nitrogenous Matter),	41.64	832.8	616.27	74	
Non-nitrogenous Extract Matter,	25.03	500.6	230.28	46	
	100.00	2,000.0	1,143.42	–	

The article is of good quality, and was obtained by bolting a coarse cotton-seed meal. Eighty-one pounds of the above was obtained from one hundred pounds of the latter. The coarse portion — nineteen per cent. — has been analyzed to ascertain its fitness as a fertilizer with the following results : —

Coarse portion of Cotton-Seed Meal for fertilizing purposes.

(Sent by E. S. Warner, Hatfield, Mass.)

	Per cent.
Moisture, at 100° C.,	7.09
Organic and volatile matter,	93.465
Ash constituents,	6.535
	100.000

	Per cent.
Nitrogen in organic compounds,	5.900
Potassium oxide,	1.797
Calcium oxide,	0.263
Magnesium oxide,	0.223
Phosphoric acid,	2.341
Insoluble matter,	1.784

Valuation per ton of two thousand pounds: —

118 pounds of nitrogen, at 18 cents,	$21 24
46.82 pounds of phosphoric acid, at 6 cents,	2 69
35.94 pounds of potassium oxide, at 4¼ cents,	1 53
	$25 46

COCOA DUST.

[Refuse from Cocoa Manufacture, sent from Boston, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	7.10	142.0	–	Not determined by actual experiment.	–
Dry Matter,	92.90	1,858.0	–		–
	100.00	2,000.0	–		–
Analysis of Dry Matter.					
Crude Ash,	6.83	136.6	–		–
" Cellulose,	5.86	117.2	–		–
" Fat,	25.85	517.0	–		–
" Protein (Nitrogenous Matter),	15.47	309.4	–		–
Non-nitrogenous Extract Matter,	45.99	919 8	–		–
	100.00	2,000.0	–		–

Essential Mineral Constituents in 100 Parts of Cocoa Dust.

Potassium oxide,	2.11
Calcium oxide,	.63
Magnesium oxide,	traces
Phosphoric acid,	1.34

The material consisted of the inside and outside parts of the cocoa bean, with some foreign matter. It was obtained in the process of cracking and sifting the bean. The examination was made by request, to ascertain its fitness for manuring. Although its nitrogen percentage (2.3 per cent.) compares well with many fertilizers in our market, it would be, for economical considerations, more advisable to try the cocoa dust as a fodder in place of oil-bearing seeds. The reputation of the cocoa as a highly nutritive food for man is too well established to doubt the efficiency of the above described article as a fodder for some kind of farm stock.

III. — Miscellaneous Analyses.

EXAMINATIONS OF SKIM MILK FOR FAT.

[Samples sent on at different times for examination.]

	Sample Numbers.									
	1	2	3	4	5	6	7	8	9	10
Amount of fat in 100 parts, . . .	.26	.31	.38	.30	.38	.37	.35	.48	.54	.48

Analysis of Milk from Shorthorn Cow.

	Per cent.
Moisture, at 100° C.,	88.45
Solid matter,	11.55
	100.00
Ash percentage,	0.72

One hundred parts of ash contained—

	Per cent.
Potassium oxide,	23.52
Sodium oxide,	14.20
Calcium oxide,	23.11
Magnesium oxide,	2.52
Phosphoric acid,	30.59

Animal had been fed largely with roots; milk yielded its butter slowly.

Analysis of Onions.

Air dry without leaves—

	Per cent.
Moisture, at 100° C.,	89.20
Dry matter,	10.80

Dry matter contained of—

	Per cent.
Nitrogen,	2.12
Sulphur,	.48
Ash constituents,	4.36

One hundred parts of ash contained—

	Per cent.
Potassium oxide,	38.51
Sodium oxide,	1.90
Calcium oxide,	8.20
Magnesium oxide,	3.65
Sequioxide of iron,	.58
Silicic acid,	3.33
Phosphoric acid,	15.80
Sulphuric acid,	Not determined.

Analyses of Drainage Waters of Experimental Plats.

	Plats No.	Parts Per Million.							Grains Per Gallon.			
		Free Ammonia.	Albuminoid Ammonia.	Total Ammonia.	Nitrogen as Ammonia.	Nitric Acid.	Nitrogenous Nitrates.	Calcium Carbonate (Hardness).	Solids.	Potassium Oxide.	Phosphoric Acid.*	Clorine.
11 A. M.,	0	.13	.09	.22	.18	3.15	.70	27.3	7.5	.18	–	.4
2.30 P. M.,	0	.11	.06	.17	.14	–	–	16.9	5.	.15	–	.4
2.30 "	1	.08	.11	.19	.16	73.19	16.26	†	†	†	†	†
11 A. M ,	3	.01	.07	.08	07	1.20	.27	28.6	4.5	.13	–	.5
2.30 P M.,	3	.45	.06	.51	.42	.83	.19	19.5	2.5	.13	–	.3
2.30 "	5	.02	.07	.09	.07	–	–	23.4	2.5	.11	–	.3
2.30 "	7	.01	.10	.11	.09	.22	.05	27.3	4.5	.18	–	.3
2.30 "	9	.02	.09	.11	.09	.28	.06	23.4	3.5	.14	–	.4
2 "	11	.01	.10	.11	.09	.41	.09	22.1	4.	.09	–	.2
11 A. M.,	13	.01	.08	.09	.07	.78	.17	22.1	4.	.12	–	.3
2 P. M.,	13	.01	.10	.11	.09	.59	.13	20.8	3.8	.21	–	.3
2 "	15	.01	.07	.08	.07	.13	.03	26.	4.5	.04	–	.3
2 "	17	.01	.10	.11	.09	.22	.05	45.7	9.	.07	–	.3
2 "	19	.01	.12	.13	.11	.78	.17	41.6	9.	.31	–	.4
11 A. M.,	B	.01	.12	.13	.11	.69	.14	18.2	2.3	.07	–	.5
2 P. M.,	B	.01	.15	.16	.13	–	–	15.6	13.3	.04	–	.4
2.30 "	C	.01	.11	.12	.10	.32	.07	18.2	2.5	.03	–	.3

* Trace.

† Not determined.

IV. Valuation of Fertilizers and Fertilizer Analyses.

The valuation of commercial fertilizers is based on the market value of their essential constituents. The market reports of New York and Boston, aside from consultations with leading manufacturers of fertilizers, furnish us the necessary information.

The statements of trade values adopted in the reports are obtained by taking the average of New York and Boston wholesale quotations of the six months preceding March 1, 1883, and increasing them by 20 per cent. to cover expenses for storage, sales, etc.

The prices stated in connection with analyses of commercial fertilizers refer, therefore, to their cost per ton of 2,000 pounds, on board of car or boat.

Crude stock for the manufacture of fertilizers, and refuse material of various descriptions, sent to the Station for examination, are valued with reference to the market prices of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

The *mechanical condition* of any fertilizing material, simple or compound, deserves the most serious consideration of farmers when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant-food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value, in case of one and the same kind of substance. Two samples of fish fertilizer, although equally pure, may differ from 50 to 100 per cent. in commercial value on account of mere difference in moisture.

As existing laws of the State for control of the trade in commercial fertilizers provides for the examination of licensed articles, the attention of the Station has been directed mainly towards the examination of agricultural chemicals, the crude stock for the manufacture of commer-

cial fertilizers, and of prominent refuse materials from manufacturing industries and elsewhere.

The work has been carried on for the purpose of aiding the farming community in a clear and intelligent appreciation of these substances for manurial purposes.

General experience in farm practice teaches that it is safer, for economical reasons, to use commercial fertilizers rather as supplements than as substitutes for barn-yard manures.

The advantages arising from the introduction of chemical and commercial manurial substances can only be secured to their full extent when applied with reference to actual local wants of the soil, and to special requirements of the crops under cultivation.

A large percentage of commercial manurial material consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industry is liable to affect at any time, more or less seriously, the composition of the refuse. A constant inquiry into the character of the agricultural chemicals, and of commercial manurial refuse substances offered for sale, cannot fail to secure confidence in their composition, and diminish financial disappointment in consequence of their application.

TRADE VALUES ADOPTED FOR 1883.

	Cents per lb.
Nitrogen in nitrates,	20
Nitrogen in ammonia salts,	26
Nitrogen in Peruvian guano, fine steamed bone, dried and fine ground blood, meat and fish, superphosphates and special manures,	23
Nitrogen in coarse or moist blood, meat, or tankage, in cotton-seed, linseed, and castor pumice,	18
Nitrogen in fine ground bone, horn, and wool dust,	17
Nitrogen in fine medium bone,	15
Nitrogen in medium bone,	14
Nitrogen in coarse medium bone,	13
Nitrogen in coarse bone, horn shavings, hair, and fish scrap,	11
Phosphoric acid, soluble in water,	11
Phosphoric acid, "reverted," and in Peruvian guano,	8
Phosphoric acid, insoluble, in fine bone, fish guano, and superphosphates,	6

	Cents per lb.
Phosphoric acid, insoluble, in fine medium bone,	5½
Phosphoric acid, insoluble, in medium bone,	5
Phosphoric acid, insoluble, in coarse medium bone,	4½
Phosphoric acid, insoluble, in coarse bone, bone ash, and bone black,	4
Phosphoric acid, insoluble, in fine ground rock phosphate,	2.75
Potash, in high grade sulphate,	7
Potash, in low grade sulphate and kainite,	4¼
Potash, in muriate or potassium chloride,	4¼

V. Fertilizer Analyses.

Dry Ground Fish.

(Sent from South Hadley Falls, Mass.)

Moisture, at 100° C.,	10.38
Total phosphoric acid,	6.00
Soluble phosphoric acid, / Reverted phosphoric acid,	2.82
Insoluble phosphoric acid,	3.18
Nitrogen,	6.13

Valuation per two thousand pounds, $36.53.

Castor Pumice.

(Collected of D. A. Horton, Northampton, Mass.)

Moisture, at 100° C.,	10.18
Total phosphoric acid,	2.13
Nitrogen (18 cents per pound),	5.69
Potassium oxide,	0.92

Valuation per two thousand pounds, $23.84.

1. Dry Fish, sent by Franklin Farmers' Club.
2. Dry Fish, sent by Milo L. Smith, Smith's Ferry, Mass.
3. Half-dry Dog Fish Pumice, sent on from Portsmouth, R. I.

	Pounds per Hundred.		
	1	2	3
Moisture, at 100° C.,	6.61	7.50	11.35
Total Phosphoric Acid,	6.17	7.67	5.85
Soluble " " / Reverted, " "	2.40	2.32	.66 / 2.20
Insoluble, " "	3.77	5.35	2.99
Nitrogen,	8.47	9.36	6.96
Valuation per two thousand tons,	$47 32	$53 18	$40 58

Nova Scotia Plaster (*Gypsum.*)

(Collected of D. A. Horton, Northampton, Mass.)

	Per cent.
Moisture, at 100° C.,	15.79
Calcium oxide,	34.29
Magnesium oxide,	0.36
Sulphuric acid,	47.14
Insoluble matter,	1.42
Carbonic acid,	Not determined.

This gypsum contained a few per cent. of calcium and magnesium carbonates, which not unfrequently are associated with it.

"*Orchilla*" *Guano.*

(Collected of D. A. Horton, Northampton, Mass.)

	Per cent.
Moisture, at 100° C.,	11.05
Magnesium oxide,	4.13
Calcium oxide,	38.24
Phosphoric acid,	21.69
Insoluble matter,	0.17

The "Orchilla" guano belongs to a class of natural phosphates which are noted for their deficiency in organic and nitrogenous matter, as well as for their large percentage of carbonate of lime. The above described sample contained 47.39 per cent. of bone phosphate, and 22.39 per cent. of carbonate of lime. The presence of so large a percentage of the latter compound renders this material, from an economical standpoint, unsuitable for the manufacturers of superphosphate of lime. The natural pulverent condition of the commercial article has favored its introduction into agricultural practice. Very satisfactory results are reported from its application in case of moist pastures and meadows, and of turfy soils. Upon a dry soil and in a dry season its action can be but slow. The safest way to secure an economical return seems to be a direct introduction in the daily product of stable manure, on account of the beneficial action of the fermenting animal excretions on the disintegration of the guano, and thus an increased solubility of its bone phosphate. Four cents per pound for phosphoric acid might be considered a safe investment. At that rate of valuation the above article would be worth $18 per ton of two thousand pounds.

Fish Pumice.

(Collected of H. L. Phelps, Northampton, Mass.)

	Per cent.
Moisture, at 100° C.,	44.41
Total phosphoric acid,	5.85
Soluble phosphoric acid,	1.57
Reverted phosphoric acid,	0 62
Insoluble phosphoric acid,	3.62
Nitrogen,	5.27

Valuation per two thousand pounds, $33.02

CANADA WOOD ASHES.

1. Sent from Sunderland, Mass.
2. Sent from Sunderland, Mass.
3. Sent from North Amherst, Mass.
4. Collected in Railroad Depot, Amherst, Mass.
5. Sent on from North Amherst, Mass.
6. Collected of D. A. Horton, Northampton, Mass.
7. White Ash, sent on from South Deerfield, Mass.

	Pounds per Hundred.						
	1	2	3	4	5	6	7
Moisture, at 100° C.,	24.50	16.66	18.70	9.30	8.10	16.70	6.62
Calcium Oxide,	33.19	32.25	30.60	34.91	39.71	35.26	50.89
Potassium Oxide,	4.77	4.97	4.61	6.50	4.96	5.55	5.23
Phosphoric Acid,	1.49	1.66	1.10	.78	.80	2.28	1.29
Insoluble Matter,	8.50	10.45	11.06	9.30	6.70	4.90	4.87

Samples 1, 2, 3, 4, 5, 6 represent the average quality of Canada wood ashes sold in our section of the Connecticut valley, at from 33 to 35 cents per bushel. Sample 7 was of an exceptional light color, and contained a larger per cent. of lime, yet compared well otherwise in composition with the others. The increasing importation of Canada ashes into various parts of the States renders it advisable to insist hereafter upon guaranteed analyses as the basis of commercial transactions.

The universal high opinion of wood ashes as a fertilizer does not depend merely upon a fair percentage of potash, but also on the presence of more or less of *all the various mineral elements essential to the growth of plants.*

Wood ashes, like barn-yard manure, on account of their compound character, meet, to some extent at least, not only known but unknown deficiencies in valuable soil constituents. The thorough mixture of their various constituents has, no doubt, a beneficial influence on their action.

8. Light-colored unleached ashes, sent by Secretary of South Deerfield Farmers Club. One bushel weighed forty-four pounds, and half pound of coarse material was removed before taking the sample for analysis.

9. Dark unleached ashes, sent by Secretary of South Deerfield Farmers' Club. One bushel weighed forty-six pounds, and two and a half pounds of coarse material was removed before taking the sample for analysis.

10. Dark unleached ashes, sent by Secretary of South Deerfield Farmers' Club. One bushel weighed forty-one pounds, and five pounds of coarse material were removed before taking the sample.

11. Collected on board cars at railroad depot, South Deerfield, Mass.

12. Collected on board cars at railroad depot, South Deerfield, Mass.

13. Collected of Mr. Almon Cowles, on board of cars, at North Amherst, Mass.

	Pounds per Hundred.					
	8		10	11	12	13
Moisture, at 100° C.,	0.70	16.98	10.28	8.33	1.03	10.01
Calcium Oxide,	50.51	36.11	32.83	45.00	50.02	35.67
Potassium Oxide,	7.38	4.90	6.10	5.91	6.94	7.19
Phosphoric Acid,	0.51	1.41	1.59	0.74	0.29	1.28
Insoluble Matter,	2.10	8.05	13.65	3.88	2.28	6.27

Nitrate of Soda.

(Collected of D. A. Horton, Northampton, Mass.)

	Per cent.
Moisture, at 100° C.,	1.25
Nitrogen,	15.57
Insoluble matter,	0.45

Valuation per two thousand pounds, $62.28

Muriate of Potash.

(Collected of George P. Smith, Sunderland, Mass.)

	Per cent.
Moisture, at 100° C.,	2.85
Potassium oxide,	50.59
Sodium oxide,	8.40
Magnesium oxide,	trace.
Sulphuric acid,	trace.
Insoluble matter,	1.50

(2. Collected of E. T. Sabin, East Amherst, Mass.)

	Per cent.
Moisture, at 100° C.,	2.89
Potassium oxide,	50.05
Sodium oxide,	8 30
Magnesium oxide,	0.60
Sulphuric acid,	0.28
Insoluble matter,	0 15

Valuation per two thousand pounds, $42.54.

This form of "German Potash Salts" has thus far proved a very reliable source of potassa for general agricultural purposes; an extensive application has caused, of late, some advance in its cost, as compared with previous years.

Ammonium Sulphate.

(Collected of Geo. P. Smith, Sunderland, Mass.)

	Per cent.
Moisture, at 100° C.,	0.23
Ammonia (equivalent to nitrogen 20.4),	24.80
Sulphuric acid,	61.60
Insoluble matter,	0.05

Valuation per two thousand pounds, $106.08.

Peruvian Guano.

(Collected of D. A. Horton, Northampton, Mass.)

	Per cent.
Moisture, at 100° C.,	14.00
Total phosphoric acid,	20.60
Soluble phosphoric acid,	3.10
Reverted phosphoric acid,	1.55
Insoluble phosphoric acid,	15.95
Potassium oxide,	1.14
Nitrogen in organic matter,	1.40
Nitrogen in ammonia salts,	3.04

Valuation per two thousand pounds, $51.66.

Tankage.

(Sent from Chicago, Ill.)

	Per cent.
Moisture, at 100° C.,	6.10
Total phosphoric acid,	12.32
Soluble phosphoric acid,	0.27

	Per cent.
Reverted phosphoric acid,	3.25
Insoluble phosphoric acid,	8.79
Nitrogen,	6.57
Insoluble matter,	0.77

Florida Marl.

(Sent from Boston, Mass.)

	Per cent.
Moisture, at 100° C.	0.60
Calcium oxide,	41.75
Magnesium oxide,	1.03
Ferric oxide,	0 36
Phosphoric acid,	2.72
Insoluble matter,	21.95

Sponge Refuse.

(Sent from Albany, N. Y.)

	Per cent.
Moisture, at 100° C.,	7.25
Nitrogen,	2.43
Ferric oxide,	0.17
Calcium oxide,	3.94
Magnesium oxide,	1 27
Phosphoric acid,	3.19
Insoluble matter,	39.05

Bones.

(Pure Dissolved Raw Bones. Sent from Amherst, Mass.)

	Per cent.
Moisture, at 100° C.,	10.23
Total phosphoric acid,	16.03
Soluble phosphoric acid,	7.76
Reverted phosphoric acid,	3.83
Insoluble phosphoric acid,	4.44
Nitrogen,	2.64

Valuation per two thousand pounds, $40.67.

Fine Ground Raw Bone.

(Sent on from Worcester, Mass.)

	Per cent.
Moisture, at 100° C.,	4.63
Total phosphoric acid,	22.41
Nitrogen,	3.69

Valuation per two thousand pounds, $43.86.

1. Bone Fertilizers. Sent by John Sanborn, Lawrence, Mass.
2. Pure Fine Ground Bones. Sent from Amherst, Mass.

	Pounds per Hundred.	
	1	2
Moisture, at 100° C.,	4.25	5.27
Total phosphoric acid,	24.06	23.18
Soluble phosphoric acid,	0.76	0.46
Reverted phosphoric acid,	3.66	3.62
Insoluble phosphoric acid,	19.64	19.05
Nitrogen,	2.88	3.73
Valuation per 2,000 lbs.,	$44 35	$46 82

"*Americo*," *A 1*, *Peruvian Guano.*

(Sent by Joseph C. Cozzen, Swansea, Mass.)

	Per cent.
Moisture, at 100° C.,	8.35
Total phosphoric acid,	10.03
Soluble phosphoric acid,	2.99
Reverted phosphoric acid,	1.72
Insoluble phosphoric acid,	5.32
Potassium oxide,	3.84
Nitrogen,	5.62

Valuation per two thousand pounds, $14.82.

PEAT.

1. Sent from Harwich, Barnstable Co., Mass.
2. Sent from Hudson, Worcester Co., Mass.
3. Sent from Holyoke, Hampden Co., Mass.

	Pounds per Hundred.		
	1	2	3
Moisture, at 100° C.,	78.26	33.61	54.28
Dry Matter,	21.74	66.39	45.72
Ash constituents in Dry Matter,	1.31	4.54	33.72
Nitrogen in wet Peat,	0.41	1.40	0.43
Nitrogen in perfectly dry Peat,	1.89	2.11	0.94

The difference in the composition of samples 1 and 2 is mainly due to their different state of moisture. Both are fair specimens of their kind. The low percentage of nitrogen in sample 3 is caused by an exceptionally large admixture of soil. Wherever the entire deposit shows a similar amount of earthy admixture, a direct cultivation, after draining, suggests itself as worth trying.

Crude Kieserit,

(Crude Sulphate of Magnesia. Of Bowker Fertilizer Co., Boston, Mass.)

	Per cent.
Moisture, at 100° C.,	31.90
Calcium oxide,	2.60
Magnesium oxide,	13.50
Sulphuric acid,	29.10
Insoluble matter,	5.00
Magnesium in form of chloride,	0.60
Magnesium in form of sulphate,	38.70

Valuation per two thousand pounds, from $8 to $10.

The "Kieserit" occurs among the salines of the salt mines at Stassfurt in Germany, which of late have acquired a particular importance as leading resources of potash compounds for agricultural purposes. Although it forms distinct layers of considerable thickness, it is quite frequently found more or less saturated with a solution of magnesium chloride when removed from the mines. Well-established experimental observations regarding the injurious influences of the latter compound on the healthy growth of roots render its presence objectionable, and consequently its removal, as far as practicable, desirable, whenever kieserit shall be used for agricultural purposes.

The removal of any objectionable percentage of magnesium chloride is usually accomplished by subjecting the crude material to a moderate calcination. The moisture present largely decomposes, at a high temperature, the magnesium chloride into hydrochloric acid, which escapes, and into magnesium oxide, which remains behind. We find, for this reason, the calcined and uncalcined kieserit in our markets. The former contains, for obvious reasons, a larger percentage of magnesia than the latter; yet it is usually less soluble in water. Both kinds ought to be well ground to render a proper distribution possible.

The kieserit, on account of a greater solubility in water, exceeds in efficiency the sulphate of lime or gypsum, as an absorber of ammonia, in manure cellars, in stables, and upon the compost heap.

Its well-known beneficial influence on a speedy diffusion of potash compounds throughout a deeper layer of soil, as well as its reputed favorable action on leaf and stem growth, are of sufficient importance to encourage experiments on the part of farmers, and in particular of gardeners and fruit growers, to test its influence. The prominence of the magnesia among the mineral constituents of many of our grain crops and fruits, leaves scarcely a doubt about its importance in the vegetable economy of many of our cultivated plants.

Potash Magnesia Sulphate.

(Collected of Bowker Fertilizer Co., Boston, Mass.)

	Per cent.
Moisture, at 100° C.,	4.90
Calcium oxide,	1.15
Magnesium oxide,	11.30
Potassium oxide,	24.94
Sodium oxide,	2.09
Sulphuric acid,	46.99
Insoluble matter,	0.54

Valuation per two thousand pounds, $34.92.

The above compound belongs to a series of salines which some ten years ago, under the name of "German Potash Salts," or "Stassfurt Salines," were introduced into our agricultural industry for manurial purposes.

Its peculiarity consists in the combination of a large amount of potassium sulphate, from 46 to 47 per cent., with a remarkable quantity of magnesium sulphate, from 33 to 34 per cent.

The magnesium sulphate stands foremost among substances noted for their quality to counteract the well-known great retentive power of most soils for potassa.

This circumstance renders the potash-magnesia sulphate a very valuable material for the cultivation of deep-rooting plants, in case of an exhaustion of potassa in the subsoil.

The potash-magnesia sulphate, as well as the "Douglass Muriate of Potash," occupy a peculiar position among our

recently introduced potash resources for manurial purposes. The former has proved the preferable compound where the presence of large quantities of chlorides is known to affect seriously the quality of the vegetable growth, as in the case of tobacco, etc.; whilst the latter recommends itself, on account of from 70 to 75 per cent. of muriate of potash, in presence of from 15 to 20 per cent. of sulphate of magnesia, for deep-rooting forage plants.

A detailed discussion of the character and special fitness of the various brands of German potash plants for agricultural purposes can be found in the annual report of the Secretary of the Mass. State Board of Agriculture for 1874.

Dissolved Boneblack.

(Of Bowker Fertilizer Co., Boston, Mass.)

	Per cent.
Moisture, at 100° C.,	20.78
Total phosphoric acid,	15.66
Soluble phosphoric acid,	12.76
Insoluble phosphoric acid,	2.90

Valuation per two thousand pounds, $31.55.

Ashes from Detroit.

(Sent by John Lane, Esq., of East Bridgewater, Mass.)

	Per cent.
Moisture, at 100° C.,	6.39
Calcium oxide,	34.15
Potassium oxide,	1.00
Phosphoric acid,	2.05
Magnesium oxide,	3.72
Insoluble matter,	22.10

The ash had evidently been leached before it entered the market.

Turf.

(Sent on by Horace Graves, Amherst, Mass.)

1. Turf from upper layer, consisting largely of leaves, roots and mosses, — brown colored and fibrous.

2. Turf from lower layer, consisting of a brown peat-like mass, taken from four feet below the surface, and exposed to the air one year.

	1	2
Moisture, at 100° C.,	25.58	13.00
Organic and volatile matter,	96.72	90.57
Ash constituents,	3.28	9.43
Nitrogen (in wet peat),	1.91	1.97

The upper layer may be used advantageously as bedding and as an absorber of liquid manure; the lower layer ought to be composted with lime or ashes before it is incorporated in the soil. Both samples are of a good quality.

Ash of Bogs.

(Sent by J. B. Wheeler, Bolton, Mass.)

	Per cent.
Moisture, at 100° C.,	5.05
Calcium oxide,	3.09
Magnesium oxide,	1.13
Potassium oxide,	0.16
Phosphoric acid,	0.93
Insoluble matter,	70.92

The ashes were obtained from the burning of the surface growth of a swamp meadow lately in part underdrained. Bogs, tussocks, and a few inches thickness of the turf, furnished the ash. The dried-up condition of the vegetable matter explains the presence of but a small quantity of potash. The ash may prove beneficial upon adjoining grass lands.

Tobacco Stems.

(Sent by E. S. Warner, Hatfield, Mass.)

	Per cent.
Moisture, at 100° C.,	8.95
Dry matter,	91.05
Nitrogen in dry matter,	2.69

One hundred parts contained: —

	Per cent.
Potassium oxide,	6.21
Sodium oxide,	0.68
Calcium oxide,	4.76
Magnesium oxide,	1.14
Phosphoric acid,	0.87
Silica, sulphuric acid, etc.,	Not determined.

Valuation per ton of two thousand pounds: —

3.80 pounds nitrogen, at 18 cents,	$9 68
124.20 pounds potassium oxide, at 4¼ cents,	5 28
17.40 pounds phosphoric acid, at 6 cents,	1 04
	$16 00

The ash of the tobacco plant usually varies less in regard to absolute quantity than to the relative proportion of its essential elementary constituents. Potash is known to vary as high as 50 per cent. in consequence of modes of cultivation and variety of soil, independent of the variety of plant. As it is claimed by good authority that an increase or a decrease of the potash in the ash of the tobacco stands in a definite relation to certain qualities of the latter, it is proposed to discuss this question more in detail hereafter.

Superphosphate.

(Of Earle & Co., Providence, R. I. Sent from Dennisport, Mass.)

	Per cent.
Moisture, at 100° C.,	9.48
Total phosphoric acid,	15.08
Soluble phosphoric acid,	7.88
Reverted phosphoric acid,	0.69
Insoluble phosphoric acid,	6.51
Potassium oxide,	2.34
Nitrogen,	2.91

Valuation per two thousand pounds, $41.64.

Haynes Fertilizer.

(Of Mr. Haynes, Bolton, Mass. Sent from Lancaster, Mass.)

	Per cent.
Moisture, at 100° C.,	17.63
Total phosphoric acid,	10.14
Soluble phosphoric acid,	5.89
Reverted phosphoric acid,	0.87
Insoluble phosphoric acid,	3.38
Potassium oxide,	5.70
Nitrogen (organic),	2.72
Nitrogen (ammonia),	0.71
Nitrogen (nitrates),	0.60

Valuation per two thousand pounds, $41.85.

VI. Chemistry in Fruit Culture.

The subject of this discussion was the outgrowth of a series of field experiments with sugar beets upon the college farm (1870–75). The beneficial influence of certain articles of plant-food on the saccharine qualities and general character of the beet-root which had been noticed in that connection, suggested the extension of the observations to fruits.

The scarcity of systematic investigations concerning the mineral constituents of fruit-bearing plants and of fruits, rendered it necessary to ascertain their ash constituents under definite soil conditions, and to study the effect of special articles of plant-food on the mineral constituents of the growth produced by their aid. It was assumed that in case some definite change in the relative proportions of the mineral constituents was noticed, a safer basis could be obtained for distinguishing between the influence of season, location, the general character of the soil, etc., and the influence of the amount and the kind of the available plant-food applied. A portion of land in charge of the horticultural department of the Massachusetts Agricultural College has been set apart for that purpose since 1874.

Wild and cultivated varieties of grape-vines were the first plants chosen for the investigation.

The experiments have been extended in the course of time to strawberries, currants, blackberries, raspberries, apples, pears, cherries and peaches.

The results obtained with grape-vines and strawberries, which have been published in previous reports of the College (1875–76), in the reports of the State Board of Agriculture (1879–80), and in the Massachusetts Ploughman (1877–78), and elsewhere, have established the fact that fruit-bearing plants respond decidedly, as far as their composition is concerned, to the application of special manures.

The currants, raspberries and blackberries raised during the past year are at present under examination, and the fruits of most of the trees will be ready for examination a year or two hence.

The appended report of Prof. Maynard refers to the present condition of these experimental fruit plats, five in number. His statement regarding the serious influence of manuring peach trees in particular, without reference to wants, deserves attention.

VII. Peaches and Peach Yellows.

The interest manifested by frequent inquiries regarding the management of diseased peach trees on the College grounds, has to serve as an excuse for introducing the sub-

ject in the present report, although little that is new and of general interest can be added beyond the fact that the restored trees are healthy and bearing, and that new trees planted in the places where diseased trees have been removed,* have been bearing healthy fruit during the past season. The subsequent observations were made on peach trees planted in 1870 in the orchard of the College, and not on the young trees upon the experimental plats of the Station.

The experiments began in the fall of 1877, when my attention was first called to the appearance of the disease in the College orchard, on the top of a knoll of light soil. The general appearance of the trees at the first stage of the disease suggested to my mind the idea that an abnormal condition of the soil might be the first cause of its development. This circumstance could be due either to a more or less general exhaustion, or to the absence of only one or the other essential elements of plant-food; or finally, to the presence of some injurious substances which might have accumulated in the soil from some cause or other in the course of time.

The gradual disappearance of the green color (chlorophyl) in the leaves, beginning at the outer termination of the young branches, — which are the most active parts of the plants for the formation of new vegetable matter, — seemed to point towards a local interference with the normal cellular functions, a natural consequence of an abnormal sap. I felt inclined to consider the fungus which, in its gradual development, disfigures the diseased parts of the tree, a secondary cause of their ultimate condition. My observations of later years with grape-vines and currants in particular, have tended to confirm in my mind the view that our troubles with parasitic growth on plants are in many instances due to an abnormal condition of the soil, rather than to a particular condition of the atmosphere. I have repeatedly noticed that plants suffered seriously from mildew and blight upon unfertilized and exhausted lands, when upon adjoining fertilized plats neither could be noticed. Diseases of plants are known to originate from internal and external causes.

* See Prof. Maynard's appended Report.

Internal troubles may be increased by external influences and *vice versa*. As the gradual change of the new foliage of the affected trees from a bright green to a white or bleached appearance, had to be ascribed to a suppressed formation of the chlorophyl, my attention was quite naturally directed to earlier observations of a similar character. Some experiments by Nobbe, Schroeder and Erdmann (Chemnitz, 1871), had demonstrated the fact that the formation of the chlorophyl — the substance causing the green color of the plants — could be controlled by the application of certain forms of potassa, engaged my particular interest. Their observations were made on rye and buckwheat. They had raised both kinds of plants under well-defined circumstances, supplying to one set the potash in the form of sulphate of potassium, and the other in the form of chloride of potassium (muriate of potash).

The plants raised with the aid of the chloride of potassium were of a vigorous growth, with a rich dark-green colored foliage, and yielded a good crop of grain. Those raised by the aid of the sulphate of potassa turned prematurely yellow and failed gradually.

An examination of the diseased lots of plants showed an excessive accumulation of starch in the cellular tissue, whilst but little chlorophyl was noticed. On the strength of these considerations, I began a systematic investigation of the disease by an analytical chemical examination of various parts of the peach tree in different stages of growth. The results of these analyses are stated below in chronological order.

A limited number of trees affected by the yellows were also selected for the experiment with special manures. The ground around the trees was treated with superphosphates deficient in nitrogen (acid rock phosphate or soluble bone-black), and each tree (about eight years old) received from two to three pounds of muriate of potash, which was sown broadcast over a surface extending about eight feet from the trunk of the tree. None of these chemicals were brought into close contact with the trees, except when spread over a heavy mulch, to prevent serious reactions on the roots. The diseased branches were cut back at the same time to the healthy wood.

The practical management of these operations was, from the beginning to the present time, under the personal supervision of Prof. Maynard.

The application of phosphoric acid and of muriate of potash was repeated the succeeding spring. The new growth of branches and leaves showed a decided improvement both in vigor and color.

The trees have been cut back for several years, and they have since repeatedly produced healthy fruit.

Analyses of Parts of the Peach Tree.

Branches in Blossom from sound Crawford Peach Tree.

(Collected in May, 1877.)

Moisture lost at 100° C.,	56.77 to 59.74
Dry matter,	43.23 to 40.26
Ash in dry matter,	– to 4.63
Nitrogen in dry matter,	2.16 to 2.09

A. — Healthy Early York Peach.

(Nearly ripe, but not mellow. Collected August, 1877.)

Moisture lost at 100° C.,	86.61 to 88.00
Dry matter (entire fruit),	13.39 to 12.00
Dry matter in pulp,	10.94 to 10.98
Specific gravity of juice at 25° C.,	1.0375 to 1.04
Grape sugar in juice,	1.35 to 1.38
Cane sugar in juice,	4.12 to not det.

One hundred cubic cent. of juice neutralized from 40 5 to 44.0 cubic cent. of carbonate of soda solution (containing 1 part in 100).

B. — Healthy Early York Peach.

(Very ripe and mellow; tested three days after picking. Collected August, 1877.)

Lost in weight within three days,	5.48
Specific gravity of juice at 25° C.,	1.045
Grape sugar in juice,	1.92
Cane sugar in juice,	6.09

One hundred cubic cent. of juice neutralized 45 cubic cent. of soda solution (containing 1 part in 100). The whole weight of the peach tested was 49.32 grammes; stone weighed 3.71 grammes; ash of entire fruit, 0.2862, including carbonic acid.

*A. — Healthy Early Crawford Peach.**

(Nearly ripe, but not mellow. Collected September, 1877.)

Moisture lost at 100° C.,	88.120
Dry matter in pulp,	11.880
Specific gravity of juice at 22° C.,	1.045
Grape sugar in juice,	1.670
Cane sugar in juice,	5.920

One hundred cubic cent. of juice neutralized 64 cubic cent. standard soda solution.

B. — Healthy Early Crawford Peach.

(Nearly ripe, but not mellow. Collected in September, 1877, wrapped in paper, and kept in a drawer for ten days. It turned very ripe and mellow, and had lost 9.50 of its weight.)

Specific gravity of juice at 18° C.,	1.050
Grape sugar in juice,	2.19
Cane sugar in juice,	7.02

One hundred cubic cent. of juice neutralized 85.6 of soda solution.

C. — Healthy Early Crawford Peach.

(Picked from the tree when turning mellow, and tested without delay, September, 1877.)

Weight of entire fruit, ... 118.06 grammes.

	Per cent.
Moisture lost at 100° C.,	88.660
Dry matter in pulp,	11.360
Specific gravity of juice at 18° C.,	1.055
Grape sugar in juice,	1.700
Cane sugar in juice,	8.940
Total ash of entire fruit, including carbonic acid,	0.344

One hundred cubic cent. of juice neutralized 76 cubic cent. of soda solution.

Ash Analyses of Crawford's Early Peach.

(Entire fruit taken from healthy and diseased trees in the same orchard. To render the differences in composition more prominent, only carefully determined constituents are reported, excluding soda, silica, etc., from the calculation.)

	Healthy Fruit. Crawford's Early Peach.	Diseased Fruit. Crawford's Early Peach.
Ferric oxide,	0.58 per ct.	0.46 per ct.
Calcium oxide (lime),	2.64 "	4.68 "
Magnesium oxide,	6.29 "	5.49 "
Phosphoric acid,	16.03 "	18.07 "
Potassium oxide,	74.46 "	71.30 "
	"	"
	100.00 "	100.00 "

* All samples tested taken from the same tree.

Although the disease was in its first stage, the results show a marked difference in regard to the relative proportion of the mineral constituents of the healthy fruit, as compared with that from the diseased tree or the prematurely ripened fruit. These results seemed to prove the correctness of my views regarding the first cause of the disease.

Feeling, however, not satisfied with an explanation based on a presumed analogy of circumstances, I invited Prof. Penhallow, in the fall of 1880, to join me in the investigation by making some microscopic observations for the purpose of establishing, if possible, more clearly the relation of the fungus to the disease.

The questions proposed to him may be summed up as follows: —

1. Is there any abnormal accumulation of starch in the diseased wood, as compared with a healthy wood? 2. Does the wood of the restored tree regain again the general appearance of that of the healthy tree? 3. What becomes of the fungus in case of a diseased tree being restored to health? These questions were to be answered by an examination of a lot of branches taken from healthy, diseased and to-health-restored trees. The three samples of branches of the peach trees, from which the previously stated specimens for microscopic observation had been selected, were each carefully examined, and the ashes subjected to a careful analysis. The branches were secured in the presence of Prof. Penhallow, Nov. 11, 1881.

Their analysis was carried on by me, and repeated under my immediate supervision by an efficient assistant.

I. Analysis of the ashes obtained from the branches of a diseased Early Crawford Peach tree.

Ferric oxide,	1.44590
Calcium oxide,	64.22920
Magnesium oxide,	10.28270
Potassium oxide,	15.67516
Phosphoric acid,	8.36690

II. Analysis of the ashes obtained from the branches of a peach tree which had been affected in previous years by the yellows, and had been restored again to health in consequence of the treatment described in preceding pages.

Ferric oxide,	0.5213
Calcium oxide,	54.5136
Magnesium oxide,	7 5788
Potassium oxide,	26.0129
Phosphoric acid,	11.3732

The differences in the composition of Ashes I. and II. are in the same direction as noticed in the ashes of healthy and diseased fruits, of the same variety of peaches.

Prof. Penhallow's microscopic observations are stated by him in the following summary: —

1. Healthy wood shows comparatively little stored starch; but fungous growth is present in the outer layers of the bark.

2. Diseased wood shows an abnormally small development of the cells, and the invariable presence of large quantities of starch; also an abundance of fungous growth.

3. Diseased leaves show the presence of fungous growth, discoloration and cells filled with starch.

4. The fungus appears first on the surface of the trunk or branches, and thence enters the woody structure, when the conditions are favorable.

5. There is little or no difference between the tissues and cell contents before and after the leaves fall.

6. While fungus is abundant on fully diseased trees, it is also to be found on trees which, *once diseased, had been restored to a condition of vigorous health.**

These results apparently confirm the views entertained when planning the investigation, and tend to show that an interior disorder, caused by an abnormal composition of the sap — as far as its mineral constituents are concerned — precedes the serious development of the fungus.

Our late advice to fruit-growers has been based on the teachings of the experiments previously described.

We recommend a careful watching of the peach orchard, to notice the disease in its first stages if possible.

The first signs are to be met by an immediate application of from two to three pounds of muriate of potash to each

* More detailed investigations of Prof. Penhallow have been recently published by him, in connection with the publications of Houghton Farm.

tree, within a radius of from six to eight feet from the trunk. This dressing is best applied upon a heavy mulch of grass or cut straw. The cutting back of the diseased branches to the healthy wood ought to be carried out as general considerations recommend. A repetition of the same treatment for one or two seasons has been usually sufficient to correct the new growth of the tree, provided the disease has not gone too far before the remedies were applied.

Besides the special treatment of the affected tree — as previously described — we have recommended as a general fertilizer for a peach orchard the following composition, which has served us well in past years: Broadcast per acre 400 to 450 lbs. acid bone phosphate, containing from 11 to 12 per cent. of soluble phosphoric acid; 125 to 150 lbs. of muriate of potash, and 75 to 100 lbs. of crude sulphate of magnesia (Kieserit).

The latter compound is added for the purpose of assisting in the diffusion of the potash, and securing available magnesia.

This fertilizer is best applied partly late in the fall and partly in the early succeeding spring. The fertilizer ought to be applied with a view to supply existing wants, rather than to promote excessive growth of wood.

C. A. GOESSMANN,
Chemist.

Assistants —

Joseph B. Lindsey, Class '83.
Charles H. Preston, Class '83.
H. J. Wheeler, Class '83.

SUNSHINE ON THE FARM.

BY

DR. JAMES R. NICHOLS.

SUNSHINE ON THE FARM.

The farmer, above all others engaged in industrial pursuits, should be an intelligent student of nature. He should love to study the laws under which the whole machinery of the organic and inorganic worlds is acting. He should become better acquainted with the secret forces which exert such stupendous changes in matter, and which are so intimately connected with vegetable growth and decay. It is not enough that the farmer studies methods by which increase of crop-results are secured; it is not enough that he learns to feed his animals under conditions which give the highest pecuniary returns; it is not enough that the best varieties of fruits are produced in his orchards; he should study the nature of the energies and forces by the movement of which his labors are crowned with success. I have alluded specially to silent and unseen agencies, and to this class belong the energies of the sunbeam. Without sunshine on the farm, all the labors of the husbandman are abortive and fruitless. We may fancy to ourselves conditions where sunlight might be replaced by artificial means. Let us bring to view a farm where the fields are rich with the best forms of plant-nutriment, where the rain falls in desired measure, where warm winds diffuse a genial and pervasive heat, but where the sunshine never comes. We may light up the broad acres with electric lamps, so that they are illuminated as brilliantly as the streets of our great cities; but with artificial light the most potent that man can invent, the fields would be practically valueless, and successful husbandry abortive.

The experiments of Dr. Siemens in 1880, in the employment of the electric light as a substitute for solar light in

* Lecture delivered at the Annual Meeting of the Board of Agriculture at Lowell.

stimulating vegetable growth, would seem to show that it may be successfully substituted under certain conditions. His experiments led to the following conclusions : —

1. That electric light is efficacious in producing chlorophyl in the leaves of plants, and in promoting growth.
2. That an electric centre of light equal to 1,400 candles, placed at a distance of two meters from growing plants, appeared to be equal in effect to average daylight at this season of the year, but that more economical effects can be attained by more powerful light-centres.
3. That the carbonic and nitrogenous compounds generated in diminutive quantities in the electric arc produce no sensible deleterious effects upon plants enclosed in the same space.
4. That plants do not appear to require a period of rest during the twenty-four hours of the day, but make increased and vigorous progress if subjected during daytime to sunlight, and during the night to electric light.
5. That the radiation of heat from powerful electric arcs can be made available to counteract the effect of night-frost, and is likely to promote the setting and ripening of fruit in the open air.
6. That while under the influence of electric light, plants can sustain increased stove-heat without collapsing, — a circumstance favorable to forcing by electric light.
7. That the expense of electro-horticulture depends mainly upon the cost of mechanical energy, and is very moderate where natural sources of this energy, such as waterfalls, can be made available.

As we look out upon our farms, let us call up before us the working-forces which are building up the plant-structures in our fields. If the day is one in midsummer, when the sun shines brightly, and moisture exhales from the odorous soil, we cannot avoid a feeling of exultation and wonder as we gaze around us, so active and energetic are the forces which are at work in building up cell upon cell in the grain and grass plants. On such a day I have frequently turned my ear to listen, expecting to hear, and even imagining I

could hear, the hum of the busy workers as their gigantic labors go forward. Consider the fact that hundreds of tons of water are lifted by millions of little pumps in the cellular tissues of the great trees in yonder forest; think of what is going on in that cornfield which stretches away to the meadow.

So constant and unceasing is the work going on under the influence of solar light, that each individual cell resembles a hive of bees in the height of the honey-harvest. Each molecule of rich material needed to build up and perfect the separate parts — whether it be the leaf, the blossom, the shining silk of the ear, or the kernel itself — finds its appropriate place, and no mistakes are made. The water which holds in solution the mineral constituents — potash, phosphoric acid, lime and silica — is started on its rounds by the greedy appetite of the spongioles springing from the roots; and the volume which is lifted and exhaled is immense. Work, work, work! All nature seems intent upon constructing and developing. There is intense activity in the air as well as in the soil; and behind this press and hurry there must be some producing cause, some force or forces which carry forward and sustain this mighty work. We have not to go far to find it; it is in the sunshine which falls so noiselessly and copiously upon the glowing fields. The earth is not the source and possessor of its own life-forces. The high power which gathers dead matter into living structures, and calls into existence all the beauties and glories of the earth, is not of our world, it is superterrestrial; it comes from the great central body of our planetary system, the sun.

Before directing attention to the nature of the solar beam, and the service it performs in clothing our fields in vestments of surpassing beauty, I must bring to view the great orb itself, and consider some of its physical and chemical peculiarities. If the question is asked, "What is possible to be known of a body ninety-two millions of miles distant from our earth?" I reply, "We know very much regarding it." Our knowledge is as positive and demonstrable relating to the physics of the sun as that relating to the nature of many terrestrial bodies. A considerable number of rather

intelligent persons doubt as regards our knowledge of the distance of the solar orb; they doubt if assumed knowledge of stellar worlds and distances has any basis of fact to rest upon. The man who did more than any other to awaken respect for astronomical science among husbandmen was not an astronomer, but an almanac-maker.

If there was any one individual whose learning I regarded with profound respect in my youthful days, it was Robert B. Thomas, that mythical man, who, although declared dead half a century ago, still continues to make almanacs just the same. When he demonstrated fifty years ago, in that useful little annual, the "Old Farmer's Almanac," his ability to prognosticate eclipses, the time of the rise and fall of tides, changes in the moon, and, above all, changes of the weather, without the use of the hateful word "probable," he silenced all cavil, and doubt of the capabilities of science, and compelled his readers to believe what they could not comprehend.

The old almanac magician is still a favorite authority; but I have to confess that my confidence is shaken in his weather forecasts since I was told by one who represents him in terrestrial life (who bears a name familiar to this Board of Agriculture), that he no longer superintends the weather-predictions, but has turned that department over to his wife, whose forecasts are more popular.

We obtain clearer conceptions of the enormous distance of the central luminary from our earth by a consideration of the time necessary for some bodies with which we are familiar to make the journey.

If the railway-train which brought us to this city could have gone on at the rate of forty miles an hour, toward the sun, without stops for fuel and water, it would not have reached its destination until the year 2246. The trip would have continued three hundred and sixty-three years. If a human being could be projected from the muzzle of one of our eighty-ton guns, and fly at the usual speed of modern projectiles, the child born at the instant of the discharge would be nine years old before the voyager reached the solar orb. If we were in telephonic communication with beings at the sun, and a question was asked of one at the other end of the wire, the questioner could eat his breakfast while the

question and answer were on the way. If the explosion of Gen. Butler's famous powder-ship, which occurred during the war, could have been heard at the sun (I doubt if it was), the sound did not reach there until 1876, twelve years after the close of the war. Light from the sun, moving at the rate of a hundred and eighty-five thousand miles in a second of time, reaches us in about eight minutes. It is across this tremendous chasm the sun exercises his power. Every pulsation of the solar surface is instantly responded to upon the earth.

In bulk it is a globe having a diameter of eight hundred and sixty thousand miles, and it would take one million and a quarter earths to make a globe of equal size. The temperature of the sun is exceedingly intense. If we heat a cannon-ball to redness, and place it in the focus of a concave mirror, the rays of heat collected and condensed by another mirror ten feet away will be hot enough to ignite phosphorus, a very inflammable body; but, if a lens only three feet in diameter be used to concentrate the sun's rays into a focus, the heat is so intense, that the most refractory solids are instantly melted, or dissipated in vapor. Platinum, fire-clay, and even the diamond itself, are fused, or changed into gaseous conditions, if they are exposed to the sun's heat at a distance from it equal to that of the moon from the earth; and therefore, if our earth should fall towards the sun, it would melt, or pass into the liquid or gaseous condition, when as distant from the solar surface as the moon is from the earth. The intensest artificial heat that can be produced reaches perhaps 4000° F. It is difficult to ascertain the exact temperature of the sun by any measurements here; but it is easy to measure the *quantity* of heat emitted.

The sun in the zenith, shining upon the earth, emits sufficient heat every two hours and twelve minutes to melt a layer of ice one inch thick over its whole surface. To produce this effect by the burning of coal would require a layer thirteen feet thick all over the sun to be consumed every hour, or two-thirds of a ton per hour to every square foot of surface. Such a fire as this no earthly furnace can parallel. At this rate, if the sun were made of solid coal, he would burn entirely out in six thousand years. These facts afford

us some faint idea of the heat-energy developed by our great central luminary. As a practical question you may ask: "What is the amount of heat which falls with the sunshine upon our farms?" If we take Joule's estimate of the mechanical equivalent of heat, which is probably correct within one per cent., and apply it to the solution of the problem, we obtain an approximative answer.

At the earth's equator, in the regions watered by the Amazon in South America, the earth receives from the sun sufficient heat upon each square foot every year to raise fifty-three tons to the height of a mile. On our farms in New England, if the heat of our summer months was continued the year round, its aggregate would not fall much below that of the tropical regions. During our cold winters our farms are covered with snow and ice, and the sun's warmth is expended largely in the liquefaction of this covering. We must not forget the paradoxical fact, that now, upon the threshold of our winter, — when the days are shortest, and the cold most severe, — the sun is nearly three million miles nearer to the earth than in July last, when the heat was at its maximum. The obliquity of the sun's rays gives us winter; not his distance from us.

The heat that falls upon our farms is disposed of in various ways; but it is largely used in maintaining the earth's temperature, as vast quantities are radiated into space. Of the immense amount received, it is probable that not more than one-thousandth part of the whole is stored up in our crops and animals, or consumed in labor. This estimate being approximatively correct, how wonderful that this minute fraction is an abundant revenue of power for the whole human race?

Do we clearly enough comprehend the fact that in the sunlight which is shed upon our farms we find the source of every form of force or energy that comes under observation? Let us briefly consider this most interesting subject; and, to render lucid the discussion, I will present a few interrogatories. What relation does sunlight sustain to the work performed by our oxen and horses, or by ourselves in our daily labor? Work, labor of any kind, is the manifestation of energy, and it depends upon chemical action, upon the

oxidation of substances in the body of man or animal. In the stomach are placed certain substances which are capable of being burned or oxidized: they are called foods. Organized substances — like corn, wheat, potatoes, etc.— are made of dead, inorganic materials by the force of solar light and heat acting upon the soil and air. Out of the dead material in our soils, and out of the dead carbonic acid in the air, living plants are produced by the solar rays. Dead material is like a watch-spring run down, so that the machinery stops. Sunlight winds up the coiled spring by forcing molecules to combine so as to form vitalized structures; and, when the substance of the structure is consumed as food, the force of the spring is expended, and is manifested in muscular labor. It is seen, then, that it is sunshine upon our fields which supplies the muscular forces of our animals and ourselves, and that from no other source is it derived. The contents of our barns, granaries, and cellars, are in a proper sense but stored sunlight,— sunlight which we have economized in the summer from the excessive supply. Whence is the power of the windmill that pumps the water for the barn and dwelling, the steam-engine which threshes the grain and cuts the succulent corn for the silo? whence that of the mill that grinds the grain propelled by the stream that comes from the hills? All these sources of power are related to sunshine, and the dynamical forces are derivable solely from the solar orb. Its heat, acting upon currents of air, expanding its volume, gives rise to winds, which move the arms of the mill. The steam-engine is moved by heat resulting from the combustion of coal or wood, which are the products of organization. Our coal-fields are but cachets, holding the fuel pemmican, stored by natural agencies, and designed for the use of man when large supplies of fuel would be needed. Coal may be regarded as the sunlight of a past epoch, utilized at a period when man had no wants; for he probably did not exist. The grist-mill on the stream must come to a standstill when clouds no longer form, and condensation of the moisture raised from oceans, rivers, and lakes by solar heat, is suspended. Every molecule of water which weighs upon the mill-wheel has been acted upon by sunshine, and, by its agency, placed in position for useful work.

In whatever aspect we regard the solar emanation, it presents itself to us dynamically as a spring of power. Whichever way we turn, we find all is motion, activity, demonstration of force. The atmosphere surges in storms and hurricanes; streams thunder over precipices; steam urges on the dilatory ship, or impels the factory; electricity carries intelligence to the world's ends; the animal world is everywhere in motion, cleaving the air, dividing the waters, burrowing in the earth, traversing the land, and putting forth power in countless forms. Yet the placid and tranquil sunbeam does the work. It is the great dynamical energy of the world. It may be interesting to consider how much working-force a farmer derives from the sun through the medium of foods. From the most careful computations, based upon the known mechanical equivalent of heat as connected with the different forms of food, it may be stated that a working-man on the farm produces in twenty-four hours an amount of heating or thermal effect equal to raising fourteen million pounds to the height of one foot. He is not, however, capable of producing in actual work on the farm mechanical effects of that magnitude. A healthy farmer, in the busy season of summer, is capable of exerting every day, in his work, mechanical results equal to raising three million six hundred thousand pounds to the height of one foot. This statement seems astounding; but it is based upon scientific data which is approximatively correct. Follow the man in the haying-season, and consider the constant expenditure of force in walking, mowing, pitching, raking, and even in breathing and eating. Two or three tons of hay pitched from the ground, through a distance of eight or ten feet, to the top of a load, requires a mechanical force, which, when accurately computed, is found to be great. The wide range between the heat-energy which a working-man produces and that which he is capable of utilizing in labor, may seem surprisingly large; but we must remember that throughout nature there is a prodigality of force manifested, and it is apparently impossible to cause the whole which is developed in any one form to be made subservient to the uses of man. We burn coal and wood for household warmth and for mechanical purposes, in devices or under circumstances the best which ingenuity can invent;

and yet we know we do not utilize more than eighty per cent. of the energy which is liberated. In man, the heat and nervous force which comes from the solar ray, is largely dissipated through the functions of the skin and lungs; and in burning fuel the great mass of the heat is lost through flues and imperfect combustion. Chemical change which results in unlocking the energies of the sunshine may proceed so slowly as to be insensible in its effects upon man, as in the rusting of metals, or in the slow decay of wood; or it may be so rapid as to utterly escape control. The stored sunshine in our barns, in the form of hay and grain, is in its utilization attended by losses corresponding with those connected with change in other forms of organized material. In modern barns, properly constructed, we are astonished to find how comfortable the temperature is when we enter them on the cold mornings of winter. It may be difficult for many farmers to realize that this warmth all comes from the contents of their hay-mows and grain-bins,— from actual burning or combustion of these nutrient materials. The long rows of cows and oxen in the stalls may be properly likened to an arrangement of little stoves, in which the products of the summer fields are burned; each animal representing a stove of greater or less capacity, according to the size. This burning is not spoken of in an ideal or poetical sense: it is actual, positive. Every load of hay which the husbandman takes to his barn from his fields in July or August is to be burned up in winter; and the exact amount of heat which would be afforded by its active combustion in the field is to be gradually eliminated from his animals in cold weather. And further: the amount of heat liberated must represent in its energizing capabilities the solar energy consumed in the growth of the grass or grain. In other words, the number of increments of heat made sensible in the organization of a cow by the consumption of one hundred pounds of hay, exactly represents the number of increments of heat in the sunshine which produced that quantity of forage. The food energies of a cow are not all expended in producing animal warmth. A considerable portion goes toward the milk-pail; and all the sunshine of our fields that

we can utilize in the cow is the milk-product and the adipose tissue resulting from the fattening process. The warmth which we experience in our barns in winter is, to a considerable extent, wasted heat-energy: it is the surplus heat generated by the animals, and which is radiated into space through the respiratory and excretory organs. We diminish this radiation of heat when we give a bucket of cold water to each animal, as is often done in the morning; and the diminution of warmth in a barn where there are a large number of animals is so great that the thermometer is sensibly affected. The same results are reached when water is thrown upon a hot-bed of coals. It requires the same expenditure of heat to raise one hundred gallons of ice-cold water to the temperature of 90° F. in the organisms of a herd of cows, that is required to raise the same to like temperature by the fires in a farmer's kitchen. As wood and coal are cheaper products than hay and grain, it follows that it is a matter of economy to warm the water supplied to milch cows in the winter-season. I but give voice to the experiences of observing farmers, when I assert that three gallons of water at the freezing temperature, given to a cow in winter twice a day, will cut short the milk-product more than six per cent. in twenty-four hours. The chemical energy requisite to produce milk cannot be diverted to heating water in the system of the cow without serious loss.

At this point several interesting inquiries arise. Since it is seen that all forms of energy possible upon our earth result from the sun's rays, what maintains this tremendous furnace — the sun? What is the fuel? How long has it blazed as now, and when will it be extinguished? These are questions which cannot be answered with any satisfactory certainty. There are reliable data, however, which enable us to know, with a great degree of positiveness, that the farmers of two thousand years ago received as much heat from the sun as we do now, and that their vines and cereal crops flourished in great luxuriance. The amount of heat received from the sun has not materially changed in the lapse of two thousand years. Geological facts show that for millions of years there have been alternations of heat and cold of great

intensity. They show that there has been enormous activity in vegetable production; and then came ice, which covered the earth's surface, except spaces along the line of the equator. We have no absolute knowledge whether the sun is growing hotter or colder, but it is probable that at present it is receiving as much heat as it throws off into space, and there is no occasion for alarm as to a failure of the supply.

As regards the nature of the fuel of the sun we have no positive knowledge. Inquiries in this direction are beset with difficulties. There are nearly as many theories as there have been distinguished astronomers and mathematicians. It may be due to meteoric matter raining upon the sun's surface, or it may be a peculiar universal atmosphere through which the sun is passing, or it may be that no fuel (in any sense in which that term is used by man) is needed by the great central orb. It is quite possible to conceive of a body losing heat for ages without changing its temperature, although changes go on in the molecular constitution of its materials. There must, however, be an end to the sun; its final extinction cannot be a matter of doubt; but at our epoch we need not give ourselves any anxieties on that account.

If asked as regards the chemical processes going forward at the sun, which result in the evolution of the stupendous quantities of light and heat received, I would say that no processes known to our chemistry are adequate to explain the problem. The hottest of all our chemical changes or combustions are as ice currents compared with the heat of the sun. It cannot be that any processes corresponding with what is known among us as combustion, can occur at the sun, or at least they fail to account for observed phenomena upon the solar disk. The heat of the great blast furnaces of Pennsylvania, which rapidly fuse thousands of tons of refractory iron ore, is but that of the wax candle when placed in contrast with the heat of the sun. Its light is so intense that if we arrange one of our electric arc lights in a way so that it may be projected upon its disk at noonday, it forms a dark spot, destitute of luminosity. The spots seen on the solar surface, and upon which a vast amount of research has

been bestowed, appear like dark patches, or like clouds in the terrestrial atmosphere, floating from the sun's equator towards its poles. These spots are of vast extent. During the past summer one was examined at my farm, with a Tolles five-inch objective, which was more than one hundred thousand miles in diameter. If our earth had suddenly fallen into the sun, striking upon this dark spot, it would have passed through the cloud without causing any special disturbance, or certainly not enough to have been noticed by astronomers at the distance of our planet from the sun. We must not suppose that these spots are destitute of light, for the brightest artificial illumination we can produce is but darkness in comparison with these sun-clouds. When floating in the solar atmosphere they seem dim, by contrast with the brighter effulgence which emanates from the luminous ocean outside of them.

The sunshine which falls upon our farms is seen to be an influence of exceeding complexity and of wonderful capabilities. Its power is not alone due to the heat which accompanies the solar beam, but the light is potent in its influence upon soils and plants.

From what has been presented in this brief and imperfect study of the solar beam, we are compelled to look upon the vegetation of our farms as a stock of deoxidized carbon and hydrogen prepared by the sun for the sustenance of animals, and for the use of man as a source of warmth and mechanical and chemical power. However we may regard the cereals, grasses and roots, which we so assiduously cultivate, they are but little masses of stored-up force, wholly due to the influence of summer sunshine, and all the skill which is called into exercise in their production, results only in removing obstacles, and brings within the influence of solar light and heat agents which aid them in their work.

We attach great importance to what are known as fertilizing substances, and we are apt to think we are dependent upon them for success upon our farms. They are at best only indirect aids ; they are molecules of inert matter which, when brought under the influence of sunlight, made subservient to its chemical power, are forced to assume higher

positions, and become integral parts of vital structures. The great end of all work upon farms is to aid sunlight in promoting those changes which cover our fields with herbage, so that men and animals may exist in the season when the sun is capable of shedding upon some portions of the earth its full measure of light and warmth.

It is only on the surface of the earth that the influence of the sun can be exerted, and it is apparent that if our planet was a fixed orb, only a part of its surface could be inhabited; but in accordance with the great plan of creation, the ponderous globe revolves rapidly upon its axis, and each portion of its surface receives a share of solar influence. All the movements of nature are brought into play only in an appointed way, and by appropriate mechanism, — there is no disturbance in her mighty movements.

The position which the laboring farmer occupies is that of a director of forces; he is not an originator: he possesses no creative power. We observe, upon two farms occupying positions side by side, that the products of one are double those of the other, and this arises from the circumstance that one farmer is a better student of nature than the other. One has learned how to aid sunlight in its work, the other makes no inquiries, wishes for no instruction, and the forces of nature, so active all around him, receive no intelligent guidance, no aid. The light that falls upon him and his acres might as well be that of the moon, a borrowed effulgence, devoid of life-giving power.

It has been stated that the two worlds of organization are condensed from the unseen gases with which our planet is surrounded. If living beings are derived from these fleeting airs, which are so rare and ethereal, may not this indicate that there is a connection between matter and spirit, and that the forces which control such wonderful changes have a celestial origin? We have in the element oxygen an agent which locks up in unchangeable forms all the products of our fields, the organizations of our animals, our houses, barns, our tools of wood, iron and steel, — all vitalized products of our earth, including our own bodies. If this agent, which has the power of pursuing to its final dissolution the entire

organic world, when called up before us by the sorcery of the chemist proves to be a gas which cannot be seen, tasted, nor felt, it cannot surprise us that the force of antagonization by which all beauty and glory upon the earth are perpetually called into being, should be the divinest affluence which can come from above, the gentle sunshine, glorious in all its attributes.

The sun is but a star, the fixed stars are also suns, many of them being a thousand times larger than our own. Their light comes to us from the profoundest distances in space. The light from the nearest fixed star occupies a little more than three years in reaching our earth, and yet, as has been stated, it travels with the incomprehensible speed of 185,300 miles at every tick of the clock. The light that beams upon us this evening from the dog star, Sirius, left that distant orb in 1879; and we have gathered into our barns the crops of four seasons since it started on its way. These allusions to stellar light are made as preliminary to the statement that the light of the stars is identical with that which comes from the sun. Luminous impulses which expend themselves upon the retina of the eye in a few minutes after they have left the central orb of our system, affect the brain in exactly the same way as those which have been many thousand years travelling from the uttermost bounds of the telescopic universe. The stellar light has the same chemical effect as solar light; it comes under the dominion of the spectroscope, and affords lines and shadows corresponding with sunlight in many respects. If stellar light was abundant and accompanied with heat, its actinic effects upon the vegetation of our farms would result in the growth and full maturity of crops. Upon how many farms on distant spheres this light falls, arousing dormant energies and bringing to view the useful and the beautiful, we do not venture even to surmise.

Our sun we know to be the great centre of vital dynamics and fountain of life impulsions; and it has charge of the destiny of our planet, alike its masses and its atoms. If it be but a solitary star among the countless hosts of the celestial spheres; if the earth be a scene of life, beauty and intelligence, only by virtue of its astronomical relations; if

the messenger of the Deity, the solar beam, comes through the spacious amplitudes ninety-three millions of miles to illuminate, vivify and people an otherwise desolate globe; if the life-exciting forces traverse stellar distances, and belong to astral systems, can we imagine even for a moment that the phenomena of life are limited to our earth? Can there be a question that organization is the product of a plan of agencies which comprehends the physical universe, and that the effect must be as universal as the cause?

REPORT

ON

MARTHA'S VINEYARD AGRICULTURAL SOCIETY.

BY

HON. JAMES S. GRINNELL.

MARTHA'S VINEYARD AGRICULTURAL SOCIETY.

Delegated by the Board of Agriculture to attend the Annual Cattle Show and Fair of the Martha's Vineyard Agricultural Society, on the second and third days of October last, I landed at Cottage City on the afternoon of Monday, the first, and was at once driven over to West Tisbury, in the centre of the island, where the society has a building and grounds for their exhibition.

The island of Martha's Vineyard, or "Martin's" Vineyard, as formerly called, — the Indian name of which was Capawack, — lies five or six miles south of the mainland, is of irregular shape, about twenty-one miles long from east to west, and from five to ten wide. It has now five towns, — Edgartown, Cottage City (set off from Edgartown in 1880), Tisbury, Chilmark, and Gay Head (formerly part of Chilmark). The eastern shore is generally a bluff, some thirty to fifty feet above the ocean, thence to West Tisbury is a nearly level plain, thirty or forty feet above the sea. The land then rises with a broken character to the west and north, in two ridges of from two hundred to two hundred and fifty feet in height for miles, the highest point being three hundred feet.

Among these hills and between the ridges there is excellent pasture, with valleys of good mowing and tillage land. There are several large brooks which, with their tributaries rising among the hills, furnish water for stock, and in some cases power for small mills.

About twenty-five years ago Dr. Daniel Fisher of Edgartown, a man of great enterprise and business capacity, who had acquired a large fortune in the oil business, believing that wheat could be grown and good flour made upon the island, bought some six hundred acres of land lying on one of the largest of these brooks, and built on the line of the brook five heavy, expensive stone dams, making as many

capacious reservoirs. At the lower one, in 1860, he built a very fine mill for grinding wheat and bolting flour, containing every appliance known in those days for perfect milling; and at that time there was not in the United States a more complete mill for making flour. He imported the best wheat grown in Maryland, and for a time made the finest flour known.

At his death the enterprise was given up, though the mill remains in perfect order, but only used for grinding corn, as no wheat was ever grown to supply it. With that supine indifference common all over the State, the farmers of the Vineyard prefer to buy their flour at a cost of twice what they could produce it for; and from 1850, when they raised the enormous crop of forty-five bushels, there has not been enough grown on the island to make an entry in the census returns down to the present time. Mr. Whiting, with a desire to stimulate wheat-raising, has grown over thirty bushels to the acre, and from one acre's produce received six barrels of superfine flour from this mill. On the south slope of the island from these hills are four large brooks emptying into the sea, and two on the north side.

Gay Head, the high point on the western end of the island, — so named from the singular and brilliant appearance it presents from the ocean, the bluff, one hundred and fifty feet high, seamed down to the water's edge with ridges of variegated clays of different colors hornblende and lignite, — gives its name to the small township, of rough but excellent pasture-land, and also to the light-house which crowns its summit. It contains an inexhaustible supply of fire clay, about two hundred tons of which are annually exported to Providence for fire-brick; kaolin or porcelain clay of the finest kind is also there found.

The last of the pure-blood Gay Head Indians died some years ago; the population left, of brave and daring boatmen and fishermen, is some Indian, some white, and more negro blood, intermixed beyond the power of any ethnological Harvey to trace the circulation.

There are upon the island, in various places, large deposits of muck, peat, vegetable deposit and swamp mud, of more or less value to compost for manurial purposes, together with

kelp, rockweed and seaweed, which is at times thrown upon parts of the coast in large quantities.

The whole extent of the island is 26,390 acres of farm land, of which 4,740 are under cultivation, 5,736 in wood, 15,716 unimproved or pasture land, and 1,298 unimprovable.

There is a great amount of good wood, largely of oak, on the northern and western parts of the island, and in the lower, moister and less exposed localities I noticed many grand oaks that would girt quite six feet.

On the south-eastern part of the Vineyard some hundreds of acres have been sown with the seed of the common pitch pine, and carry trees thirty and forty feet high, showing well what might be done with enterprise and patience. These have not suffered from a fungoid growth, destroying the foliage and trees, as have the pines on the neighboring island of Nantucket. Whether they were the same variety no one could inform me.

Remains of submarine forests have been found at Vineyard Haven and in other places, showing that the island was once heavily wooded, as also Gosnold, the first discoverer, so states.

A large part of the territory is good farming land, and would compare favorably with that of almost any town in eastern Massachusetts, or indeed with many of those on the hard hills of Worcester West or Franklin, and is susceptible of producing much more than it now yields.*

The Vineyarders have long been noted for their hospitable and cordial treatment of visitors; they are a hardy race and have sent over every sea on the globe their brave sailors and skilled fishermen, who carry with them such a devoted fondness for their island home, that it ultimately brings back to their beloved Vineyard almost all who are not "in the deep bosom of the ocean buried."

* In "Letters from an American Farmer," printed in 1782, which attracted much attention at the time, and after, Hector S^t. John, the author, says, — "Edgar is the best seaport and the shire town. Chilmark has no good harbor, but the land is excellent, and no way inferior to that on the continent. It contains excellent pastures, convenient brooks for mills, stone for fencing, etc. Tisbury is remarkable for the excellence of its timber, and has a harbor where the water is deep enough for ships of the line. The stock of the island is 20,000 sheep, 2,000 neat cattle, besides horses and goats. They have also some deer and abundance of sea fowl."

Martha's Vineyard owes most of the prosperity that attends her to the whale and other fisheries, for although at the highest, in 1845, she had but fifteen vessels and $250,000 capital, all from Edgartown, her brave men manned the ships from other ports, and from before that to the present time returned with their hard earnings to invest them in farming. Our census returns show that of the classified occupations there are in Dukes County four hundred and thirty-four persons engaged in the fisheries, and three hundred and thirty-four in agriculture.

The total domestic and agricultural products are $149,128.

The products of the fisheries are $133,797.

The total of farm property, $799,283 (which is capital).

The capital in the fisheries is $220,695.

Thus it will be seen that the agricultural products gave to each person engaged in agriculture $446.50 for the year; and the products of the fisheries $308.33 to each person in that occupation.

The agricultural products return but 18⅔ per cent. on the capital invested, while the fishery products give about 60½ per cent. on the invested capital.

There are on the Vineyard one hundred and fifty-four mariners and forty-four master mariners, who, I presume, take a hand at farming, occasionally. Indeed, I was told that more than half the farmers were also fishermen, and that in addressing a full-grown Vineyarder as "Captain," I would be right three time out of five.

Still there is a great deal of agricultural earnestness among them all, and I do not believe there is a society in the State where its bounty is better earned, more largely distributed, and so generally appreciated, as in this very one.

The three south-eastern counties of the State, where the soil — whatever it was in the earlier days of dense woods, festooned with the vines of the purple grape, which delighted the eyes of the discoverers, and gave to this district the distinctive and captivating title of Vineyard — is much of it sand and drift, and not so responsive to the labor of the husbandman as many other more attractive lands in other parts of the State and country. The occupation of fishing, often very remunerative, and fascinating from its dangers, and the

temptation to follow the sea is so strong, that many leave, preferring to plough the ocean than to continue the same-named operation on the unresponding sands of the Cape.

The Vineyard, while suffering with the other two counties, is peculiar, as showing less change in its population than any other county in the State, probably due much to this controlling love of their home, — this *nostalgia* which will not admit a permanent expatriation.

Nantucket has not so large a population now as she had in 1790. She culminated in 1845, and has been waning ever since. Barnstable has 4,000 less than she had twenty years ago; and the Vineyard has increased but a thousand over the 3,265 she had a hundred years ago. For the first fifty years, with occasional set-backs, she added but about five hundred inhabitants, and has only increased her population the other five hundred since 1840, and that increase has been in Edgartown and Tisbury.

Dukes County, including Gosnold, according to our State census, the only one giving opportunity for comparison, contains 33,945 acres of farming lands, in 371 farms; having 4,893 acres of cultivated land, appraised at $30.12 per acre; 18,000 acres of pasture or unimproved land at $9.34; 9,200 acres of woodland at $12.42, and 1,858 acres of unimprovable at $1.43 per acre.

On these 371 farms are 978 buildings, or a little less than three buildings to each farm; in that respect a little better than the average of the State.

The average value of all the buildings on each farm in the State, of which there are two and two-thirds, is about $1,482; the average value of all the buildings on each farm in Dukes County is about $666. The value of the individual buildings on each farm in the State is less than $560 each; in Dukes County each building on every farm averges $253.

The domestic animals on each farm in the State are valued at about $388; those on the Vineyard farms at about $260.

But the item showing their greatest deficiency and a neglect of good farming, and consequently a loss of products and of profits, is that of agricultural implements and machinery. This not only shows in figures, but was discernible at the fair and in the fields, and is a matter of com-

mon remark among themselves; it indicates thriftlessness and lack of wisdom which, until amended, will always stand in the way of successful farming.

The average value of the agricultural implements and machinery on each farm in the State is about $120; of the same in Dukes County, $39, or less than one-third of what farms average throughout the State.

No farmer, nor set of farmers, can use old-fashioned, clumsy, past-dated tools, and stand in the same rank or successfully compete with those who keep abreast of the times with the new and perfected implements and machines of the present day.

To use a shackly, one-horse wagon of ten bushels capacity, with a patched and rotten harness, for carting out manure, instead of a strong, handy dump-cart for one or two horses, and the same for harvesting; or an old-time, rickety plough, an old-fashioned A harrow, for preparing the land, and a little old one-horse plough or corn harrow, in place of a fine iron or improved wooden-beam steel or chilled-iron plough, a wheel harrow, a Thomas smoothing harrow, and a shapely Planet cultivator or Prout's horse hoe, for properly cultivating the growing crop; or a mere scythe with a ten-year-old snathe, a hand-rake and fork for getting in hay, instead of a good mowing machine, a tedder and a horse rake; and an old spade to chop up such roots as he may have, instead of an easy, quick-working vegetable and root cutter, shows in any farmer an inert, inactive disposition, quite inconsistent with the spirit of this age, which so long as it prevails will most assuredly hinder the advancement of him who uses such tools, and just as surely will drive the succeeding generation of boys from the farm to the lively employment of braking freight cars on a railway, driving a city grocer's wagon, or to cast their bread on the waters from a mackerel smack or a whale-boat. Farming at the best is a laborious occupation, a constant struggle against the forces of nature. The elements, excessive moisture or drouth, heat and cold, all kinds of vermin and insects above the surface of the ground and below it, dependence on middlemen, and the inability to unite and to make and sustain fair paying prices for their products, are all combined to make

the farmer realize that primeval malediction — "Cursed is the ground for thy sake; in sorrow shalt thou eat of it all the days of thy life; thorns and thistles shall it bring forth to thee, and in the sweat of thy face shalt thou eat bread."

To make farming profitable to the old and endurable to the young, as it may be, not only hard manual labor and thoughtful brain work are needed, but every mechanical appliance for lightening labor, hastening work, and easing the team, the boys and the men outside, and that of the women within, should be brought into operation, so far as is possible, on every farm in the Commonwealth.

I know these remarks are not germane to a report on the Vineyard Fair, but I cannot lose this opportunity to iterate what has been often forcibly said, that the farmer who scrimps his beasts, his family and himself, pinching their stomachs, and depriving himself and his household of everything but the bare necessities of living, toiling early and late in all weathers, risking his health, often inducing sickness, and generally induing himself with a full and permanent suit of rheumatism, all to scrape together day by day small driblets with which, when they amount to a hundred dollars, he hastens to the nearest savings bank, burying it for the small returns of three and a half per cent. a year, — does not have the same happiness in his family, does not accomplish the same good for his neighbors and the community around him, and finally does not, with all his savings-bank investments, leave his family in as respectable and comfortable condition as if he had turned his money back on the farm, in bettering his buildings within and without, making the waste places a fruitful spot, by clearing, ditching and reclaiming land, in buying improved animals for increased products, and improved implements and machines which should ease the unceasing work in his declining years; by liberal management and generous treatment attracting and retaining around him, in one or more comfortable farmer's homes, those children who, repelled by the hardships and unloveliness of the cheerless farm, have sought more congenial situations, and have found sympathy and appreciation in other occupations and in other parts of the country.

The temperature of Martha's Vineyard is much more favorable than in the most of the State, not varying much from that of Nantucket, where there are two hundred and thirty days without frost, while the other parts of the State only enjoy from one hundred and forty to one hundred and sixty, the lowest temperature in winter being from 18° to 25° higher than in the Connecticut River Valley. The Vineyard, however, has some advantages over Nantucket in not receiving the sharp northeast winds which sometimes sweep down around Cape Cod but hardly ever touch this island. It is a noticeable fact that while the mean summer temperature of the water in Massachusetts Bay is 52°, in Buzzard's Bay on the south and in the water around the Vineyard and in the Sound, it is 72°. The influence of the Gulf Stream seems to be very perceptible on the south shore; three times within the past twenty years the islanders have been visited by the golden mullet, a very delicate fish of the South, and never known to be north of the Carolinas. Some years ago a true pelican was shot in one of the salt ponds opening into the sea.

While fishing will always be a large element in the support of the inhabitants of Martha's Vineyard, there is an item I think likely to bring a considerable revenue to the island which, though not agricultural, may be one which the farmer-fishermen of this locality can pursue, and it is oyster culture.

The enormous consumption of this popular bivalve has already created anxiety as to the supply, which many intelligent fishermen fear will not keep pace with the demand.

Prof. Baird of the United States Fish Commission, who is doing more than any one man in this country to increase food supply for the people, has, with Prof. Riley and other assistants at the Station of the Commission at Wood's Holl, found a safe, sure and expeditious way of producing oysters by artificial fecundation.

But beyond this, and which is of much more consequence, is an economic plan for retaining in large ponds or aquaria for the purpose, the embryo or spat after fertilization, till the young oysters shall, free from all outside dangers, attach themselves to twigs, fascines, shells, prepared tiles, and other

things arranged for them, till they are large enough to be safely planted out in suitable beds. When it is known that a large female oyster will produce about 60,000,000 eggs, it will be at once imagined how small a proportion of them ever grow into oysters that come to a market. When in a state of nature most of them are swept away in the salt water unfertilized, and the others are for a long time defenceless, subject to destruction by every variety of marine enemies; but if they can be preserved in their tender infancy the increase can be controlled to an almost limitless amount, and safely and economically transplanted to suitable beds, where they will rapidly grow.

There is a number of ponds on the southern shore of the island and some on the northern, admirably adapted to the planting and cultivation of oysters, when they can be furnished as readily, as safely and as cheaply as Prof. Baird thinks they can be from his Station.

These ponds, separated from the ocean by only a few feet or rods of a sand bank, are very suitable for this purpose, having a sandy bottom, fed by fresh water from the land side, which can readily be made salt enough by cutting channels through the narrow sand banks into the ocean three or four times a year, with a few days work of men and teams, through which at high tide the salt water will flow in, sufficient to make the water brackish enough for the oysters, — to furnish them food and lime for their shells, and to bring the water to the specific gravity of 1.010 to 1.020, the proper range for oyster culture. Oysters bred in these ponds would have a great advantage of freedom from their worst enemies, the star-fish and the drum, which would not be likely to get into the ponds, and if they did, the water would be too fresh for the dreaded star-fish to live in. These ponds being comparatively shallow, the oysters would probably grow and fatten very rapidly.

It seems probable to me that before long the people of the Vineyard may be able to export many thousands of bushels of oysters of good quality, grown at a comparatively small expense.

The whole character of the eastern end of the island has been changed within a few years, having become a place of

great summer resort, first by the Methodists, and later by comfort and pleasure seeking people, who, attracted by the fine air, delicious breezes, and the grand ocean scenery, have made permanent residences there, mostly in the shape of "cottages," from the small box of twelve feet by twenty-two, to the large, ornate, pagoda-like structures of many wealthy proprietors.

The "cottages" of all kinds now number about twelve hundred, and in the height of the summer season, when the camp-meeting is being held, and the hotels and cottages are filled, it is said that there are not less than twenty thousand people on the island.

In 1835 the first modest beginning of a Methodist camp-meeting here was made at "Wesleyan Grove," in the town of Edgartown, on high land about five miles north of the village, in a beautiful oak grove. Nine tents were pitched, and some eight hundred people attended the services. The beauty, the seclusion, the wholesomeness of the location, with perhaps a touch of sentimentality, finally decided the people of that persuasion in the south-eastern part of the State, in 1868, to take an act of incorporation, with authority to hold land and other property, and to make rules and by-laws for their government and protection.

Such has been the marvellous growth of this place, set off from Edgartown, and incorporated as "Cottage City" in 1880, that now one thousand cottages of all kinds are spread over the ground in which twenty thousand worshippers supplant the place of the few hundreds and the nine tents of fifty years ago.

While these consumers, with not one item of production among them, not so much as a head of lettuce or of that most insignificant of vegetables, a single radish, are to be fed, many of them for three months or more, one would suppose that market-gardening would have become quite extensive, and that the business of supplying all these people with the common spring and summer vegetables and berries would form a very important item in the Vineyard resources; but I was told that most of the articles of this sort were brought from Boston and New York by way of New Bedford, as well as most of the meats.

But surely the Vineyarders could arrange with the marketmen and supply them with better vegetables from their own gardens than those from the mainland two or three days old. According to the census of 1875 (though matters have improved since that, but the Federal census does not descend to such small things), no asparagus, no lettuce, salads nor greens, no celery was raised and sold on the island; only fifteen bushels of tomatoes, two thousand quarts of strawberries, fifteen hundred bushels of sweet corn, and $332 worth of cucumbers, — a very small part of the consumption of from ten to twenty thousand people in three months. Of the lambs sold the census report give no return; but the farmers told me that owing to New Bedford competition they could not get paying prices. There is something wrong in this, for they can and do have earlier and fatter lambs than the New Bedford market can afford, and with the class of people who summer on the island, and with proper arrangements with the dealers, they ought to make their lambs a very paying product.

Of dressed poultry they sold, during the year, $3,270 worth, and of eggs, $6,300 worth. The poultry and eggs together amount to $700 more than all the beef and pork killed on the island.

Of pork they made 43,133 lbs., the number of pigs not given; but if each one dressed 250 lbs. it would only make one hundred and seventy killed, — not half a pig for each farm on the Vineyard, — which we, on the continent, would think pretty small allowance, and which, I should suppose, would not be enough with which to fry the orthodox codfish-balls, let alone what should go into the honored pot that holds the inestimable baked beans.

Of beef they slaughtered during the year 47,720 lbs., and if the reported hides corresponded there would have been seventy-three beasts dressing 654 lbs. each; but while Tisbury gives fifty-eight hides to 15,000 lbs. of beef, making each one dress about 260 lbs., Edgartown apparently wrapped in one hide 5,900 lbs. of beef, showing that the hide does not always go with the carcase. The Vineyarders received 9^6 cents for their beef against 9 cents average of the State; for their 13,830 lbs. of mutton, $12\frac{1}{2}$ cents, against

the rest of the State 9 cents; and for their pork 10¾ cents, against 10 cents elsewhere.

In 1858 Mr. Henry L. Whiting of the United States Coast Survey, and now one of the Harbor Commissioners of Massachusetts, having some years previously bought a farm in West Tisbury, had become impressed, in his official visits to every part of the island, by a belief that with the concerted action of the farmers in a society receiving the bounty of the State, the possibilities of increasing the agricultural capacity of the Vineyard, having naturally a good soil, and rich in beds of peat, muck, and in the drifting seaweed, might be largely extended.

Having interested some leading farmers they took the first steps towards providing the necessary funds, and the Martha's Vineyard Agricultural Society was accordingly incorporated in February, 1859, the necessary land purchased, and a convenient building erected by the following October, when the society held its first cattle-show. The society seems by the returns to have been successful. It has gradually paid off all its indebtedness, at one time over $2,000; it pays annually for premiums entirely within the purview of the law as strictly agricultural, more than it receives from the Commonwealth, and it pays nothing for horse-trotting.

The morning of Tuesday, October 2, the first day of the Fair, was about as stormy and unpromising a day for a cattle-show as the calendar could show, with a howling south-east wind and a pouring rain.

Notwithstanding this, which must have kept away many even of these amphibious islanders, to whom water presents few terrors, there was a fair attendance of farmers with their animals.

Over sixty entries of neat stock were represented by more than seventy head of oxen, cows and young creatures, many of which were very good. The milch cows, with a cross of Ayrshire, and occasionally of Jersey, looked well, considering the very dry condition of the pastures. Two or three yokes of steers were very fine, and would have been creditable at any fair in the State; the young cattle, though pinched by the drought and curled up by the pelting storm, were promising looking.

There were in 1879 upon the island 1,381 head of neat stock, 557 of which were milch cows, and 274 oxen and steers, which, as working animals, I was glad to see, had not entirely gone out of use. In 1845 the islanders had 1,820 neat cattle; in 1850, 1,709; in 1855, 1,690, and so on, decreasing at every decade to the present time, or rather to the time of taking the last census for the year 1879. Since that, I find by the State valuation returns that the milch cows have increased to 738 — a very satisfactory gain for three years.

As butter is a large and profitable product here, the Vineyarders are very properly cultivating the Ayrshires and the Jerseys.

I would most strongly urge upon the members of this society to bring into the island one or more pure-bred Jersey bulls, as I learned that they were quite commonly breeding to grade bulls, a practice which will surely run out their stock, and certainly will not permanently increase their good milk and butter cows, which are what they want.

Of swine there were but four entries. There are but 265 swine on the island anyhow, not one for each farm, let alone the 1,473 other dwelling-houses. The Vineyarders have something to learn about the profitableness of keeping pigs. With such an extent of pasture land, the best place for them on the farm in summer; and for winter, with sea-weed to be had for the hauling, and 390 tons of salt hay, which might be largely increased, and with inexhaustible beds of real muck, how easily they could grow and fatten pigs; especially as they have from their butter-making about 270,000 quarts of skimmed milk, and from their cheese about 2,800 quarts of whey, with which the young pigs can be most successfully started. What they do with all their skimmed milk I don't see. The 20 calves they vealed, and the 212 they raised in 1875, couldn't use it all, for they made in that year 313,388 quarts of milk, from which they made 15,416 lbs. of butter. In 1880 they sold 183,584 quarts, and also made 22,782 lbs. of butter, which, at even twelve quarts to a pound of butter, would require the skimming of 273,384 quarts of milk. So much for pigs.

Of sheep there were twenty-four entries, covering forty-

seven animals. The islanders still continue to regard wool as the prime object in sheep raising, considering the flesh of mutton and lamb as secondary, and accordingly offer, first, premiums for fine-woolled sheep, and then for natives and grades; and this, too, when their 9,225 sheep only shear 25,782 lbs. of wool, or two and three-quarters of a pound to the sheep, worth twenty-six or twenty-seven cents per pound, while mutton is worth ten to twelve cents per pound, and early lambs from six to eight dollars each, and grass lambs from four to six dollars.

Every delegate who has visited this society has commented upon its capacity for raising sheep and lambs for market, and has recommended the introduction of some of the hardy Down sheep to give good shape and early maturity to the lambs, and has insisted on the importance of shelter and better care for the winter than the sheep on the island are wont to receive, to keep the ewes in condition, to save the lambs and to improve the fleece. Perhaps a comparison may stimulate them. Franklin County, with 11,000 sheep of all kinds, — including wethers, barren ewes and yearlings, — raises over 8,000 lambs, which are valued straight through at $4.35 each, and sends to market over $16,000 worth of mutton. Dukes County, with a safer sheep-raising country and over 9,000 sheep, raises only 1,400 lambs, valued at $1.50 each, and sends to market only $1,700 worth of sheep meat. The islanders say that the improved sheep are not hardy enough for them. No sheep that wears wool *is* hardy enough to thrive, scarcely to live, on such treatment as most of these Vineyard sheep receive, when they are kept the whole winter unhoused and scantily fed, if at all. It is no wonder that the wool comes off, becomes dead and of little weight; or that they raise less than 16 per cent. of lambs to the sheep, while the Franklin County shepherd, by care and feed, brings up 95 per cent. of his lambs, and reckons at least 125 lambs to the 100 ewes.

With such a range of pasture, and with winters ninety days or more shorter than ours in the interior, the islanders ought to beat in market with early and grass lambs every county in the State, except Nantucket. They are comparatively free, too, from ravages by dogs. It is said that

history repeats itself. In the matter of sheep husbandry in this State this is true, so far as this.

In the laws of Massachusetts Bay, October 18, 1648, it is enacted that, "if any dog shall kill any sheepe, the owner shall either hang his dog forthwithe or pay double damages for the sheepe; if the dog hath bene seene to course or bite any sheepe before, not being set on, and his owner hath had notice thereof, then he shall both hang his dog and pay for the sheepe."

In the legislature of 1882 the Massachusetts Senate passed an amendment to the "dog law," to the effect that if the owner of any dog having killed sheep was known, he should pay for the sheep or kill his dog.

This harmless and wise enactment was in the House attacked by a Boston lawyer and dog-breeder so effectively as to defeat it, by abuse of the dog law, ridicule of sheep husbandry and derision of the farmers, thirty odd of whom there present sat cowed, abashed and tongue-tied as the dog owners triumphantly killed the bill. Truly the men of 1648 were wiser in their generation.

The display in the hall was exceedingly good. The women of the island are as skilled with the needle as those of a former generation were with the spinning-wheel and the loom.

Seventy-five years ago there were here three carding mills, which carded 6,000 lbs. of wool, and there were two fulling mills, which dressed 4,000 yards of cloth, out of the 17,775 yards of all kinds which the women of the island wove on the eighty looms in the various farm-houses, valued at about 75c. per yard, and they knitted 7,406 pairs of woollen stockings, worth $4,448.

There was a large display of useful and of very handsome articles of needlework, and the very great interest felt by the women of the island, and their ingenious and active industry, were manifested in 342 entries of the different classes of needlework, fancy work, worsted work, mats, rugs and knitting, with the inevitable bedquilts.

To almost any one of these busy workwomen might be applied the words of the wise man, "She seeketh wool and flax and worketh willingly with her hands."

Of bread of all kinds there were fifty-eight entries, much of it looking very palatable.

There were twenty-four entries of butter, looking well, and some as fine in appearance and taste as would be found anywhere.

There were four entries of fair-looking small cheeses.

The Vineyard, in the last census year, 1879, produced 705 lbs. of cheese; in 1875, — perhaps by some mistake of the assessors, — only 70 lbs., and that from Chilmark. In 1850 and in 1855 they made over 4,000 lbs. Strange as this decline seems, from that to 705 lbs., it is only one per cent. greater than that in the great cheese-producing county of Berkshire, and in the State at large, — on the farms. But in the State, the cheese factories produced a third more than double all that was made in home dairies, and there is no factory in Dukes County.

There were 22,782 lbs. of butter made on the island in 1879, 15,000 in 1875, 14,000 in 1870, 14,700 in 1865, 18,000 in 1860, 28,000 in 1855, 23,000 in 1850, and 20,000 in 1845. In 1879 they sold 45,896 gallons of milk; no price given. In 1875 they made 78,347 gallons, valued at 22½c. per gallon, as against 17c. for the rest of the State. Unfortunately, our census for that year is deficient in not discriminating between the milk sold and that made into butter and cheese. In 1870 they are reported as selling 8,565 gallons, and in 1865, 16,189 gallons.

Apparently the cows of the island do not come up to the standard of those of the State at large, which averages 1,183 quarts to a cow, while that of Dukes County is only 570 quarts by the census of 1875, and 670 by the census of 1879.

The vegetables were very good, — cabbages, squashes, and various turnips, — while the potatoes could not be surpassed in quality. The apples and some other fruits were uncommonly good, considering the very dry season which everywhere prevailed.

Cranberries, eleven entries in number, were of two varieties, the large, light-colored, bell-shaped, and the small, round, dark-red kind, more solid and more valuable than the larger and handsomer ones. It seems to me that this should be a much larger crop on the island than it is. There

are now between thirty and forty acres in cranberries, part cultivated and part natural bog.

The expense of preparing a cranberry meadow, "bogging," levelling, sanding and setting, varies from $250 to $400 per acre, if labor and team are hired, dependent on the "lay of the land," facility for draining and flowing, and the convenience of sand for covering the meadow. Moisture is indispensable, and much labor required to keep out grass and foul stuff indigenous to such land. The plants will give a full crop about the fifth year, and after that, except for frosts or destructive insects, against which flowing is the protection, will with care yield to the acre from fifty bushels up into the hundreds, worth from three to five dollars per bushel. One meadow there was mentioned as having the past season produced ninety barrels on two acres, then worth $12 per barrel, and waiting for a rise, — $540 for an acre's crop. I was told that there are many acres which could be brought into cultivation for this valuable vine, and readily flowed, which is a prime necessity to the successful cultivation of a cranberry meadow.

I believe this crop will yet be a very important one for the people of Martha's Vineyard,

The second day of the Fair was beautiful, and brought out these good people in crowds.

To these Vineyarders, isolated as they are, — doomed never to see on their ocean-bounded home the gorgeous gilded chariot which bears on its pinnacled height visions of spangled beauty, which soon after float through the air on a trapeze, or on a bare-backed, fiery steed, whose lack of apparel they strive to rival, dashing recklessly around the ring of "the greatest moral show on earth under canvas;" forbidden as they are by the "dissocial sea" ever to view there the pride, pomp and circumstance of contingent war, which wraps in blue and yellow glory the bloodless warriors of the mainland, as they follow the rattle of the spirit-stirring drum and "the vile squeaking of the wry-necked fife," or the booming band in full imperial uniforms, through the perils of a sweltering Fourth of July or the horrors of a wet muster in September, — the cattle-show is their great holiday, a combination of all the shows on the mainland. They come for

good, honest, unrestrained enjoyment, and they have it. Not a sign of disorder or incivility or intoxication was noticed. All were happy, and listened to a band from New Bedford, which gave satisfactory music and pleased the people.

The exhibition of horses continued at intervals through the second and third days.

A ploughing-match came off at eleven o'clock on the farm of Mr. Whiting, of two horse-teams and one of oxen, attracting but little attention. One of the ploughs was a novelty there — a Casaday sulky plough — which did good work, and was a great credit to the owner who had the enterprise to introduce such an advanced implement on the island. There was a base-ball match between two local clubs, a foot race and other civil games to amuse the crowd.

On Thursday the third day, in the afternoon, the large hall was crowded; the very handsome and able address of Mr. Everett A. Davis, which justly gave great satisfaction to the members of the society, some music, a few short speeches to while away an hour, and the twenty-fifth exhibition of the Martha's Vineyard Agricultural Society had become a thing of the past.

Two hundred and eighty-one years ago last May, Capt. Bartholomew Gosnold discovered the "Vineyard." First landing on the small island now called "No Man's Land," he gave it the name of "Marthae's," or "Martin's" Vineyard. The larger island upon which he went the next day, about four miles north, has, however, retained the name to the present time. He then sailed round the high bluff at the western end, now known as Gay Head, which he called Dover Cliff, from the somewhat resemblance to the chalky cliff of that name which he had recently left behind him in his English home.

He anchored in a splendid bay which he called "Gosnold's Hope," and from there selected one of a group of small islands between the Vineyard and the mainland, which he called "Elizabeth," in honor of his mistress the queen of England, where he established a settlement intended to be permanent, but which, however, continued but one month, as those who came with him as settlers expecting to be

planters, frightened by the Indians, and thinking their supply of food to be insufficient, sailed back to England, thus ingloriously leaving the first settlement ever made by white men in New England. They carried with them, beside some furs, about one hundred tons of sassafras (still abundant in that neighborhood), regarded at that time as a sovereign specific for a certain disease then prevalent, enough they thought to glut the drug market of London.

On what is now called "Cuttyhunk" they dug and stoned a cellar, built a log house and fortified it with stockades. Within a few years the cellar was distinctly traced, but now the inconsiderable town of "Gosnold," with its one hundred and fifteen inhabitants, is the only monument to that brave captain who made the first settlement in New England, and who, five years afterward, when, with the famous Capt. John Smith, endeavoring to found a settlement in Virginia, died of a terrible plague.

Although the colonial charter of 1692, from William and Mary, conveyed with other territory this island to our forefathers by the name of Capawack, with no allusion to any Martha, the colonial government soon after in the same year assumed for it the name of "Martha's Vineyard," which it has ever since borne, though perhaps it might seem that the reasons for calling it by that name rather than "Martin's," are not quite conclusive.

The antiquarians who decided this depended entirely upon the "relation" of Gabriel Archer, a gentleman who, with John Brenton and others, accompanied Gosnold; but the subsequent record evidence is much against them. An eminent historian says that "it is greatly to be regretted that the history of the discovery should have been so neglected."

The account of this voyage exists only in "Purchas' Pilgrims," printed in 1625, and consists of three papers. One is a good, stately, but filial letter to his father from Gosnold himself, somewhat descriptive of his voyage, but mentioning no name as given to this island.

The narrative of John Brenton, who accompanied Gosnold, is interesting and quite particular; but he gives no name.

Gabriel Archer, who was also in Gosnold's small vessel, carrying thirty-two persons, twenty of whom intended to

settle as planters, was the only one of these who made any record. Archer's "relation" is a very interesting paper. He says Gosnold named the small island "Marthae's Vineyard;" and again mentions the name with the same spelling. When Archer wrote this, whether at the time or from memory afterwards, does not appear. His "relation" is certainly incorrect in some particulars as a careful study of the voyage will show. In coming by Cape Cod, which still bears the name given it by Gosnold, he says they steered west. If they had done so there would have been a speedy ending of that voyage. He should have said south. He is also confused in his statements of the islands, and of the navigation after leaving Cape Cod; and he may be incorrect in the writing of this name.

In 1603, the next year after Gosnold's return, Capt. Martin Pring or Prynne, spelled differently by different writers, made a voyage to the same places discovered by Gosnold, but makes no mention of the name of Marthae's Vineyard. Nor from 1602 down to the landing of the Pilgrims, and long after, although some voyage was made to that or some place near, as often as every other year, was there any use of that name by any one as known.

Nearly forty years — long enough for the inaccuracy of forgetfulness to have obliterated any certain recollection of the name, — had passed, when Mr. John Forrett, agent for the Earl of Stirling (who claimed, under a grant from the "Plymouth Company," given at the order of Charles the First, all the islands on the coast from Maine to the Hudson River), in 1641 conveyed, with Mr. Frederick Vines, agent for Sir Ferdinand Gorges, "to Thomas Mayhew and his son Thomas Mayhew, Jr., of Watertown, the right to plant on Martha's Vineyard and the Elizabeth Isles, the same at he had previously granted of the Island of Nantucket."

In 1644, and once in 1659, Mr. Thomas Mayhew writes as from Martha's Vineyard, but in all other cases from "*Martin's*" Vineyard. In 1643 the settlement was established at Edgartown by a detachment of colonists with their young minister from Watertown, which was a colonial hive for swarming. In 1644 was one of the early acts of the "Commissioners of the United Colonies of New England," that

the government of Massachusetts Bay may receive "*Martin's* Vineyard into their jurisdiction if they see fit," it never up to that time having been under the control of any of the colonial governments.

In 1650 Mr. Thomas Mayhew, the grantee under Lord Stirling, who seems to have devoted himself to christianizing the savages, writes from there that the "natives of 'Martin's' Vineyard were mostly Christians, and that all the island was in a measure leavened."

In 1654 Capt. Humphrey Atherton was authorized "to pasture sheep on 'Martin's' Vineyard and Nantucket, he performing the law for keeping sheep."

In 1658 the commissioners of the united colonies wrote to Mr. Thomas Mayhew of "Martin's" Vineyard concerning the Indians there.

In 1662 one John Doggett (who might reasonably have complained when they wrote his name Doghead), of the island called "Martin's" Vineyard, at the October court at Plymouth, complained against the town of the said Vineyard for the title of certain land in the enjoyment of which he was disturbed, and prevailed. Nicholas Morton and John Pease of "Martin's" Vineyard were appointed to answer to the suit. This same Doggett, at the July court in Plymouth, complained against one Geo. Robinson of "Martin's" Vineyard for defamation, and Robinson was ordered "to pay five pounds, and to make acknowledgment to the court and at home on training day at the head of the company."

October 25 of the same year Doggett was tried for "uncivil carriage" to Mary Robinson and acquitted.

The same year the commissioners of the colonies wrote Mr. Robert Boyle, governor of the "corporation for the propagation of the gospel among the Indians," that Mr. John Eliot had baptized divers of the Indians on "Martin's" Vineyard.

The next year Simon Bradstreet, president of the commission, wrote Mr. Boyle on the matter of the Indians at "Martin's" Vineyard.

In 1664 Mr. John Eliot asked that ten pounds be paid to Samuel, an Indian of the church of "Martin's" Vineyard, as a teacher at Nantucket.

In 1667 there was ordered by the government to be paid for schools, to Thomas Mayhew of "Martin's" Vineyard, thirty pounds, and for nine teachers, all at "Martin's" Vineyard, thirty-two pounds.

In the same year, in an investigation, King Philip denied killing persons on "Martin's" Vineyard.

In 1672 there were paid for Indian teachers on "Martin's" Vineyard and Nantucket fifty-seven pounds.

In 1680 a protest was entered before Nathaniel Morton, secretary of the court, by Alexander Watts, master of the sloop "Anne and Elizabeth;" sailing from New York, on his course from "Martin's" Vineyard he went ashore on Cape Cod.

In 1681, by order of court, Samuel, an Indian boy, was bound as "prentece" to the widow of John Tucker, late of "Martin's" Vineyard.

Thus much for the fourteen instances from the earliest colonial records of Plymouth and Massachusetts Bay, where this island is called "Martin's" Vineyard, and not one where it is written Martha's. From 1664 till 1692 the island was under the government of New York, and the following is the record there: —

In 1641 James Forrett, agent of the Earl of Stirling, and Richard Vines for Sir Ferdinand Gorges, conveyed to Thomas Mayhew of Watertown, and Thomas Mayhew his son, "the right to plant and inhabit on Martha's Vineyard," as granted on Nantucket.

The same year Thomas Mayhew and his son sold a "large towne" on Martha's Vineyard to John Doggett and others, — and that's the last of "*Martha's*" Vineyard in the New York records of the islands.

In October, 1659, Thomas Mayhew of "Martin's" Vineyard sold the island of Tuckanuck to Tristram Coffin and others.

May 14, 1670. — In the minutes of the council of New York, at Fort James, Mr. Mayhew's business of "Martin's" Vineyard was taken up. A letter was read from Mr. Mayhew, desiring "to be resolved in what nature 'Martin's' Vineyard and those parts are, as to government." "The patent of the duke includes 'Martin's' Vineyard," etc.

"The duke's patent, wherein 'Martin's' Vineyard is included is shown to young Mr. Mayhew."

The same year and month Gov. Lovelace wrote to Mr. Thomas Mayhew about his land in "Martin's" Vineyard, and also sent official notices to all who held any interest in "Martyn's" Vineyard to appear, etc.

June 28, 1671. — Governor and council to the petitioners of Nantucket: — "They may join with their neighbors of 'Martin's' Vineyard," etc.

July 6, 1671. — Governor and council having under consideration Mr. Mayhew's affair about "Martin's" Vineyard: "Mr. Mayhew to bring in what he hath bought at 'Martin's' Vineyard," etc.

Before the governor and council, July 7, 1671: — Granted, that the court is first to be held at "Martin's" Vineyard, etc. "Mr. Mayhew is to be governor over the Indians at 'Martin's' Vineyard."

July 8, 1671. — Gov. Lovelace issued commission to Thomas Mayhew, to be governor of the island, "Martin's" or Martha's Vineyard.

Same year. — Gov. Lovelace commends to the governor of New Plymouth, Mr. Thomas Mayhew of "Martin's" Vineyard.

1674. — Gov. Andros of New York issued order for settling government in "Martin's" Vineyard.

1675. — Thomas Mayhew, "uppon 'Martin's' Vineyard," writes: — "I had a grant of Mr. James Forrett, agent to the Lord Stirling, for these isles," etc.

1675. — In council, a petition being presented by Mr. Tristram Coffin and Mr. Matthew Mayhew, from "Martin's" Vineyard.

April 29, 1675. — Gov. Andros issued orders for the courts of the two islands of "Martin's" Vineyard and Nantucket, etc.

Sept. 28, 1675. — Council voted "to send a great gun to each of the two islands, Nantucket and 'Martin's' Vineyard."

1685. — Thomas Dongan, lieutenant-governor of New York and vice-admiral, orders the pursuit of a pirate vessel, supposed to be near to "Martin's" Vineyard.

1687. — Gov. Dongan confirmed to certain parties their rights on a certain island lying southeast of "Martin's" Vineyard, known by the name of Nantucket; an island which was purchased heretofore for a valuable consideration by Thomas Mayhew, Sr., of "Martin's" Vineyard, and Thomas Mayhew, Jr., his son, of James Forrett, agent to William, Earl of Stirling, etc., and referring to Gov. Lovelace's, patent of exactly the same words to Thomas Mayhew in 1671.

Aug. 12, 1692. — Council minutes upon reading a letter from Maj. Mayhew of "Martin's" Vineyard, etc.

Oct. 31. — Order of council concerning the government of "Martin's" Vineyard.

Feb. 10, 1692. — Council of New York addressed the king against any attempt to take from New York "Martin's" Vineyard, etc.

Here we find in the colonial records of New York three instances of the island being called "Martha's," and sixteen where it is called "Martin's." This ends the colonial record, but there is some recorded evidence of tradition outside, showing that the island was only known as Martin's Vineyard.

Thomas Lechford, a lawyer who lived some years in Boston, in his "Plaine dealing, or newes from Newe England," in 1641, is the first one to speak of this island before it was deeded to Thomas Mayhew. He says: "Eastward off Cape Codd lyeth an island called 'Martin's' Vineyard, uninhabited by any English."

John Josslyn, in his "Voyage," written in 1670, says: — "Twenty miles out to sea, south of Rhode Island, lyeth 'Martin's' Vineyard, in the way to Virginia. This island is governed by a discreet gentleman, Mr. Mayhew by name. To the eastward of 'Martin's' Vineyard lyeth Nantucket island."

John Winthrop, in the "History of New England," says in 1643: — "This yeare some of Watertown began a plantation at 'Martin's' Vineyard beyond Cape Cod."

In Hubbard's "Indian Wars," published in 1677, a rude map, one of the first drawn of New England, shows "Martin's" Vineyard south of Rhode Island.

Nathaniel Morton, in his "Memorial," published in 1669, says, "The Isle of Capawack now called 'Martin's' Vineyard." *

William Hubbard's "History of New England" in 1680 calls it "Martin's" Vineyard.

It would seem as if all these citations might throw some doubt as to what should be the real name of this island when not one instance is found of its being called "Martha's" Vineyard. Gosnold named the island north of the Vineyard, where his permanent settlement was to be located, Elizabeth, for his queen. Virginia had already been named for her. Later, Cape Ann and Annapolis were called for Queen Anne, and Maryland for the consort of Charles I.; but there was no royal Martha, no distinguished woman of that name, save her of St. John's gospel, who had died some time previous, having been canonized July 13, A. D. 303, and there is no suggestion of any other woman for whom he should have called it.

In the voyage down the coast Gosnold gave to unimportant localities convenient names. To "Cape Cod" he gave the name it has ever since borne. "Point Care" he called a dangerous shoal on which he nearly ran. Another headland he called "Point Gilbert," for Bartholomew Gilbert, an explorer and captain of the time, and second officer on this voyage. A reef uncomfortably near their course he named "Tucker's Terror," from the alarm it gave one of his voyagers, and "Gosnold's Hope" was Buzzard's Bay; and it is probable that he might have called the small island at which he touched for some friend or promoter of his voyage, most likely for Capt. John Martin, with whom not long after, he sailed to Virginia, both being members of the governing council of the "London Company," and undoubtedly friends as they were co-workers in this undertaking. On the one hand we have a "relation" made by one accompanying the discoverer, who himself, with all the others, are silent on

* A later edition of this interesting work, by the learned and venerable Judge Davis, has a copy of the map taken from "Hubbard's Indian Wars," described as "A Map of Newe England, being the first that ever was here cut, and drawn by the best pattern that could be had, which, being in some places defective, it made the other less exact, yet doth it sufficiently show the situation of the country, and conveniently well the distance of places."

this matter. When this was written, at once, or long after the voyage from memory, we know not. This "relation" was not printed, and this name not known, for more than twenty years, and then only by a single mention in only one book, with a curious spelling, and not recognized after that for nearly twenty years more, when the owner, who had received it by grant without a name, conveyed it through an agent, presumably taking the one he gave from Purchas, where it stands to this day, with no imaginable reason for its bestowal. On the other hand, we have an unbroken tradition, running from any time after the discovery of the island down to 1692 of individuals most directly interested in the island, — of the grantee and owner, — of various of the inhabitants, — of all the historians of the times, and of the records of three colonial governments and of two courts of judicature, — all agreeing on a name for the giving of which there was good occasion, and which would have been quite consistent with the discoverer's habit of giving names to unimportant localities.

Tradition is often more conclusive, more thoroughly convincing than a questionable writing, and especially so when its sources are consentaneous and unvarying. Upon tradition depend many of the facts and deductions in that holy book which is our guide in this life and our directory for that which is to come. How much, too, of historic lore, interesting, valuable and fully credited, has come down for years before being embodied in print.

Will it be deemed an impertinent inquiry by a curious but unlearned investigator, with all these citations before him, whether Capt. John Martin, as a brave explorer of this new world, and as an associate and co-worker with Gosnold, had not as reasonable chance to be immortalized in the nomination of this fair island by his friend its discoverer, as any unheard of, imaginary and improbable *Marthae?*

JAMES S. GRINNELL.

ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

1884.

ANNUAL REPORT.

To His Excellency the Governor and the Honorable Council:

The year that has passed will doubtless prove one of the most important in the history of the college. The energy, the wisdom and the devotion of Dr. Chadbourne, who died Feb. 23, 1883, aided by many friends of the college, have begun to yield fruit promising lasting benefit to every section of the State. It is seldom that an institution is subjected to so severe a loss as the college sustained in his death. Speaking of his acceptance of the office early in 1882, a member of the Board of Trustees says: —

"After due consideration, he consented to accept the proffered position, and lost no time in entering upon the duties it involved. The State College at that time needed all the energy, oversight, executive ability, ripe experience, innate enthusiasm and educational resources which such a man only could supply. Rarely have a man and his work so happily met. He seemed to comprehend the extent and peculiarity of the field on which he had entered, as it were with a single steady glance; and it at once became obvious that the college was to have the benefit of a masterly mind and character."

In the obituary sketch which is found in the Alumni Record of 1883 Prof. Bassett thus speaks of him: —

"During the period of his service here, President Chadbourne impressed himself upon faculty and students as a man of power and sincere purpose. All have caught in some measure his earnest, resolute spirit. He imparted an impetus to the college which has become a vigorous internal life. His plans were large, his execution prompt and effectual. The erection of a commodious drill

hall, the improvement of other buildings and their surroundings, and the revision of the curriculum, are evident features of his work. More valuable, even, were his services in securing to the college the interest and confidence of the people. . . . He is mourned by associates in business interests, who found him enterprising and sagacious; by the champions of pure legislation and civil-service reform, who will miss from their councils one whom they knew to be fair-minded in his opinions, unflinching in his convictions, and fearless in assault upon false systems and corrupt institutions; by the people of Massachusetts, who esteemed him a trustworthy citizen, actuated by pure motives for the public weal; by fellow-members of scientific and literary associations, who valued his scholarly labors and respected his high attainments; by the friends of truth and righteousness, nation-wide, who honor him as the foe of evil and the advocate of true religion; by hundreds of men who have caught inspiration from his teachings and wisdom from his counsels; by the trustees, faculty and students of the college to which his last strength was given. Few men have touched human life at so many points or with so firm a hand. Few have exerted influence so permanent; written records so fair; bequeathed memories more fragrant. None have been more loyal to high purposes; none more true to convictions of duty."

We cannot specifically state the good work for the college attempted by Dr. Chadbourne, but we are able to give the general outline of what he proposed, in his own words. Speaking of the act of Congress, in accordance with which our own college and those in other States were founded, he says: —

"Whatever mistakes may have been made in the organization and management of these institutions, no fault can be charged home to the original bill. It was eminently a wise measure, and suggested an outline of organization and management that has not as yet been improved upon. Its significant words are as follows: 'The endowment, support and maintenance of at least one college where the *leading object* shall be, without excluding scientific and classical studies, and including military tactics, to teach such branches of learning as are *related* to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the *liberal* and *practical* education of the industrial classes in the several pursuits and professions of life.' No branch of learning peculiar to the old colleges was to

be necessarily excluded; but the new colleges were to push on to the practical application of the sciences they taught, and they were to train all their students as defenders of their country against domestic rebellion or foreign invasion. In a word, they were to educate their students as *men* and as *American citizens*. The rank of the education given is '*liberal*,' the term applied to the education given by the highest institutions then known. It was to be so broad as to fit men for the 'several pursuits and professions of life.' . . . Many who have attempted the management of these colleges, as well as many who have criticised them, have apparently overlooked the broad and generous plan upon which they were founded. It is doubtful if they will ever accomplish the great work for which they were intended, until their original purpose is so fully and constantly recognized and carried out by judicious, painstaking work, that the currents of education shall be once fairly turned toward these new channels. When once fairly turned, that they will continue to flow can no more be doubted than we can doubt the success of any natural process when not artificially obstructed. An education that 'gives boys what they need to daily use when they become men,' commends itself as rational and practical."

The plan as thus in general outlined secured the hearty approval of the trustees, and its execution was well begun when Dr. Chadbourne was suddenly removed by death.

From the time of his death until the beginning of the present college year, the affairs of the college were wisely administered by Prof. H. H. Goodell, as acting president. As he was unwilling to assume the duties of the presidency permanently, the trustees, by a special committee, sought a successor to Dr. Chadbourne. After much inquiry and careful deliberation, it was determined to secure the services of James C. Greenough, a graduate of Williams College, who, by his early training, was skilled in agriculture, and who, owing to his administrative ability, his acquirements, and his success in teaching, had already been urged to accept the presidency of a classical college in another State. Mr. Greenough refused to allow his name to be used as a candidate, but as the trustees, through their committee, persistently urged the need of his services at the college, and the wide field for usefulness which it presented, he at length severed his connection with the State Normal School in

Rhode Island, and entered upon his duties as president in September, 1883.

Course of Study.

After a careful study of the condition and prospects of the college, President Greenough determined to specifically work out the plan proposed by Dr. Chadbourne. The studies of the college course are now so arranged as to form two general courses of study. One is termed the Scientific and Agricultural Course, the other is termed the Scientific and Literary Course. The first provides for all the agricultural study which our facilities allow. We are increasing the opportunities for special instruction in agriculture as fast as we can. We believe it will be for the advantage of the State to invest more in the farm as a means of agricultural training. To make the farm the effective basis of a training school, considerable expenditures must be made. To secure desirable practical results, a variety of crops should be cultivated under different conditions, as a means of instruction rather than of profit. In training to any employment so varied and complex as agriculture in its several departments, there must be loss of material.

The Scientific and Literary course of study is adapted to those whose previous practical knowledge of agriculture, or whose choice of other employments than that of tilling the soil, requires that less time shall be spent in field work. The college, as now organized, offers its course of instruction to any young man who is qualified to pursue it. The question may here be asked, "Do not other colleges in the State provide for the instruction of those who are not to be farmers?" The other colleges in the State require for admission to their regular course from two to four years' preparatory study of Latin and Greek. Many students cannot afford to give so much time to the study of these languages before entering college, and wish to pursue other branches during their college course. These students need the culture that comes by the study of language and literature, and this they must secure by the critical study of the English language and by the study of the modern languages. Some

of those who were graduated at our older colleges, and who appreciate the culture there gained, prefer for their sons the more practical course at the State College. This college, as now organized, fills a place in our general system of education that no other of our colleges can fill. It meets the wants of those who have been trained in our common schools, our high schools and our academies; but who have not pursued a course of preparatory study in Latin and Greek. It supplements the work in the English department of our high schools, as the older colleges supplement the work of the classic department.

It is evident that the State College must lack that organized support which the older colleges are able to secure through their graduates. Owing to the brief period during which the college has been established, its graduates are yet young men and comparatively few in number. They have not acquired that wealth and influence which will be theirs at the close of another decade, yet they have evinced a deep interest in the welfare of the college. They have begun to contribute liberally toward the establishment of a library fund for the college. The success of the graduates in their several fields of labor, and their zeal for the welfare of the college, augur well for its future.

But the college is not a private institution, and neither the alumni nor the trustees can so regard it. Its appeal must be to the people of the State, and this is just, for it is organized to meet their wants. It is not organized upon the basis of any mediæval models. It is a State college, organized to serve the present interests of the people, by providing practical instruction for a large and increasing number of young men. It should be so liberally sustained, and the expense of attendance should be so reduced, that every boy in the State will consider it possible for him, by industry, frugality and faithful study, to find a path through it to competence and usefulness. It must be steadily adapted to meet the wants of our young men, especially of those who are to engage in the productive industries.

The question may here be put, "By thus broadening the field and the work of the college, will it not lose its value as an 'agricultural' college?" In answer to this we may say,

that if the institution is narrowed to the special needs of those who are to till the soil, it becomes a mere technical school, and loses the distinctive characteristics of a college. Every college must do something more than teach the technics of any employment, or it is no longer a college. The objects of study and training are two, — to form the man and to form the workman. The work of a college is, mainly, to develop manhood. The object of an agricultural college is to form men, and also to furnish special training for those who are to till the soil, or are to direct others in tilling the soil. No narrow structure was contemplated in the broad foundation proposed by the act of Congress, under which the Massachusetts Agricultural College was established. It has ever striven to make men, though it has often suffered the misfortune of being considered a mere training school for farmers. This view is degrading to the farmers and to their employment. Technical training without liberal culture subordinates the man to his employment, and tends to make him something less than a man. The full course of study, as now arranged, is needed by every young man who attends the college, whatever may be his future employment.

But the question may still be urged: "How is this college to aid the agricultural interests of the State?" In reply to this question, we would say that the college enables a large class of young men to prepare for wide usefulness who cannot pursue, or who do not wish to pursue, the courses of study in the older colleges. Through the intelligent labor of these graduates, agriculture and other productive industries of the State will receive fresh impulse, and will be more wisely developed.

The question may be asked: "How does this college promote the agricultural interests of the State as other institutions of the State do not?" We answer: —

1. By providing special opportunities for the culture and training of those engaged in agricultural pursuits, thus emphasizing the importance of such pursuits.

2. By recognizing the value of a thorough education for those engaged in agricultural pursuits. The day is past

when it can be said that a farmer needs little or no education beyond the ability to read, to write and to cipher. His success to-day depends upon his ability to understand the principles of physics involved in the machinery he uses. By means of the mechanical contrivances of our time, the farmer is now able to accomplish quickly with his horses what was once slowly accomplished by hand. The great advance in agricultural chemistry renders a knowledge of the principles of this science necessary to the farmer who would correctly note the changes in the laboratory of nature, and read the books and papers published to aid him in his work. The progress in the cultivation of fruits and vegetables renders it needful that he understand the laws of plant life. The study of botany is becoming more and more a necessity. The laws of animal life are also indispensable to him who would intelligently care for the animals in his charge.

But the college recognizes the fact that the farmer needs more than scientific and technical knowledge. He needs to know himself and his relations to his fellow-men. He needs to be able to wisely discharge the duties of citizenship. He needs to be a man qualified for that leadership in public affairs which in the past has secured to our land the wise counsel of her yeomanry.

3. By providing for that instruction and training in the field which is requisite to success in every department of agriculture. Agriculture is an art as well as a science, and hence it demands manual training.

4. By giving those engaged in agricultural pursuits an opportunity to gain a scientific education adapted to their needs. All the sciences taught in the college are taught in their relations to agriculture.

Every scientific principle taught in a college course must be presented in some of its applications in order to be understood. In the State College the applications are made in the several departments of agriculture and in kindred employments. We here touch one important difference between the proper work of the State College and the work of other institutions. For instance, the principles of chemistry are the same whether taught in one place or in another. The illustrations and the applications by which the principles are

taught and understood are not the same in every institution. In the State College the illustrations and applications relate to agriculture. The same is true of botany, and should be true of every department of science.

This is the only justifiable mode of teaching sciences in an agricultural college. This mode is none the less serviceable to those who are not to be farmers. There is no better way of understanding the sciences than by the illustrations and applications taken from the field. Those who are thus taught, whether their future employment is in the field, or shop, or office, cannot fail to be interested in agriculture, and may be expected to co-operate with farmers in devising better methods of developing the productive industries of the field.

But scientific training is not sufficient to form the true man, nor the wise leader of others. That one may wisely forecast the future, he must study the past. History properly finds its place in our curriculum. Every young man entering upon active life should know the social forces acting about him. Civil polity, political economy and kindred studies should not be disregarded in any college course. Every graduate should have knowledge of his own mental and moral powers, and the laws of their proper exercise. Hence studies that lead to this knowledge are wisely incorporated into the course of the college.

In the modern discussions respecting the value of scientific studies, the necessity of literary culture is too often overlooked or denied. No course of study is liberal from which is excluded that culture which is the result of the patient study of language and literature. This college excludes an extended course in the study of the ancient classics, hence the greater the necessity of providing other means of literary culture. Here, if nowhere else, the English language, both in its spoken and written forms, should be thoroughly studied. Because of their aid in a knowledge of the English language, and their help in its use, Latin, to some extent, French and German, should be patiently studied. There are many other evident reasons for the study of these languages at this college which it is unnecessary to mention. The thorough work which has been

done in the department of literature and language should be increased. Every student should be trained to accurate, effective and graceful expression, both oral and written. No one is prepared for the battle of life until he is ready to find solace, inspiration and guidance by converse, through our literature, with the great masters that have preceded us.

Nor is the course, as thus partially outlined, sufficient. Man is a religious being. The college should provide means of religious culture. The brief chapel exercise of each morning, and the Sabbath services now regularly held, together with such other means of religious culture as are now provided, we believe are essential to the highest welfare of every student.

Gifts to the College.

Gifts to Library.

From Leander Wetherell, of Boston, 1,410 bound volumes, including complete sets of Agricultural Reports of Ohio, New York, Vermont, and several hundred pamphlets.

From Herbert S. Carruth, of Boston, seventy volumes of latest publications in history, science and literature.

Gifts to Museum.

From the United States Fish Commission, a representative collection, numbering some two hundred species of the invertebrates of the coast.

From W. E. Rutherford, of Westhampton, a collection of one hundred and fifty specimens of birds' eggs, containing some quite rare species.

Gift to Botanical Museum.

From William S. Lyon, of Los Angeles, Cal., over two hundred specimens of the flora of California, to the herbarium of the college.

Gift to the College.

From the United States Government, a set of weights and measures, to be kept as a standard of authority. (Joint Resolution of Congress, March 3, 1881.)

Immediate Needs of the College.

1. The North College is well-nigh unfit for occupancy. Repairs have been made from time to time, but, owing to the fact that the building was hastily and cheaply built, and has been subjected to constant wear for some fifteen years, it needs a thorough renovation. The estimated cost of the repairs and necessary improvements is $5,000. Unless this building is put in good condition, it will be impossible to accommodate the next class that enters.

2. A house on the grounds, to be occupied by the president and his family, is an admitted necessity. President Chadbourne selected a site, and the trustees were planning to build, at the time of his death. At the time of the appointment of President Greenough, it was agreed to provide a house upon the grounds. A balance in the treasury of the college justified the trustees in beginning the house in August. As the funds of the college did not allow us to finish the building, nothing has been done upon it since the early days of November, when the first coat of plastering was put on. It did not seem wise to stop the work at an earlier stage. The amount expended upon the house is about $2,000. The amount needed to pay outstanding bills, and to complete the house and the grading, will be $6,000. It will be more economical for the State to complete this house than to continue the allowance for house-rent agreed to be paid to the president until it is finished. The main reason, however, for completing the house, is that the services of the president, when living on the grounds, will be of far more value to the college than they can be while he is obliged to live at a distance of a mile from the college.

3. The room now used as a chapel for morning and Sabbath services is part of the chemical building. The increased work in the chemical department of the college demands that the whole building shall at once be occupied by that department. In fact, much of the work incident to the Experiment Station is now accomplished with difficulty, because of the lack of room in the chemical building. Our present chapel room must be given up to the chemical department. Where, then, shall the students assemble for

morning service, for lectures and for Sabbath services? The only way of meeting this question is by the erection of a chapel. When this building is erected, provision should be made for a library. We have noticed elsewhere the gifts of Leander Wetherell, Esq., and others to the library. We have no suitable room in which to put these books. Hon. Marshall P. Wilder has agreed to place a set of books, which cost him upwards of $500, in the library, as his gift. These books would be of great practical value to the college; but we cannot transfer them to Amherst until the State shall provide a suitable place.

During the month of December, in response to the solicitations of the President, several thousands of dollars were pledged, as a permanent fund for a library. Most of this was pledged by certain gentlemen now on the board of trustees of the college. If allowed, we would gladly give the names of those who have thus provided a permanent library fund. Three thousand dollars have been collected, but all of the remainder cannot be collected, nor the income used, unless a suitable place is provided for keeping the books. The alumni of the college are also moving to secure an alumni fund for the library. It is seldom that one of our State institutions has received such gifts as are now proffered. Whether these gifts shall be available depends upon the action of the present legislature.

In the accompanying reports some of the needed appliances by which the work of the several departments of the college can be made more effective, are specifically noted.

Scholarships.

The class that entered last September was, for the most part, made up of those admitted by competitive examination, in the several senatorial districts, under the direction of State senators.

The faithfulness of the senators in giving notice in their several districts, and in arranging for examinations, indicated an earnest purpose on their part to extend the usefulness of the college. Though the measure was new, and but partially understood in many sections of the State, sixty-six of those examined reached the required rank and were

admitted to the college. The lack of means and other circumstances have prevented some of these from attending. Upwards of fifty have been in attendance, constituting one of the best classes that was ever admitted to the college. This class will be increased by others who are soon to be admitted. The number admitted from Franklin County is larger than from any other county in the State.

Concluding Remarks.

Those who enter this college are, with few exceptions, young men who have learned by their own labor the value of money, and are disposed to make the most of their opportunities for study and personal improvement. They are worthy of more liberal provisions for their wants at the college than the State has yet made.

The members of the Faculty are something more than excellent instructors of classes; they care for the students individually, and the students, in turn, cordially co-operate with their instructors.

As the experiment station is now separate from the college, we present, in connection with the reports of the several departments of the college, a list prepared by Dr. Goessmann of the more important experiments carried on at the Massachusetts Agricultural College since 1870.

DEPARTMENT OF PRACTICAL AGRICULTURE.

President JAMES C. GREENOUGH.

SIR: — The following report on the course of instruction in this department, for the year 1883, is respectfully presented: —

In accordance with arrangements which assigned a part of my time to work in connection with the experiment station, my duties at the college have been strictly confined to instruction in the class room.

Owing to a revision of the courses of study, at the beginning of the year, it has been necessary to give instruction in special topics in a different order than that laid down in the regular course, to bring the standing of the several classes in agriculture in harmony with the curriculum published in the catalogue.

From the want of suitable text-books, instruction in agriculture must be given almost entirely by lectures, and a certain amount of mental discipline, particularly in the habit of concentrated systematic attention, is required on the part of the student to enable him to derive the greatest profit from them. For this reason, it seems desirable that the course in agriculture should not begin until the last term of the freshman year.

My aim has been, in all parts of the course, to give prominence to the practical principles of the art, which represent the accumulated experience of the best farmers.

The mission of science, in its relations to agriculture, in its several departments of physics, — chemistry, biology (including animal and vegetable physiology), and political and social economy, — is to explain the established methods of practice, interpret the more exact results obtained in

experiments, and to suggest new lines of experimental inquiry in regard to improved methods of practice.

The applications of science to agriculture have, therefore, been discussed with reference to their bearing upon questions of practical importance, and particular attention has been given to the results of experiments which have been made for the improvement of the art.

One of the leading objects, in the course of instruction in agriculture, is to develop in the student correct habits of observation, and give him a knowledge of the exact methods of experimentation which are required for the solution of the many problems that may present themselves in his practice. Empirical knowledge is thus brought in contact with a consistent interpretation of natural laws, and practice and science are thus made to go hand in hand in the class-room, as they must in the work of the farm, if the student is to receive the full benefits of an agricultural education. Theories are discussed with reference to their legitimate use as a means of investigation, and they are not presented as representing the aggregate of established truths.

In the second term of the year, lectures were given to the sophomore class (two hours a week, or nineteen exercises) on the history of agriculture, tracing the development of rules of practice, — pioneer farming and mixed husbandry, — and the properties and management of different soils.

The junior class had a course of lectures on animal husbandry (one hour each week).

The course of the senior class (two hours per week, or nineteen exercises) embraced methods of agricultural improvement, including experiments and how to conduct them, the methods and results of high farming, and the nitrification of soils, with the practical applications indicated in the results of experiments.

In the third term, lectures were given to the senior class (five hours per week, or forty-five exercises) on stock-breeding, mixed husbandry, drainage and a general review of the course.

In the first term, the sophomore class had twenty-six exercises in stock-breeding and animal motors, partly by lectures and partly with text-book.

The junior course consisted of twenty lectures on manures and crop rotations, and a course of lectures (twenty-six exercises) was also given to the senior class on stock breeding.

In addition to the regular class work, a number of illustrated lectures have been given to the students generally, and to the members of the Natural History Society, on topics relating to agriculture not embraced in the regular course.

Lectures to farmers' clubs have likewise been given in different parts of the State.

A class-room is very much needed for the use of this department, and it should have connected with it a room for apparatus and for preparing experiments to illustrate the course, and an agricultural museum.

The advantages of object teaching in the course of instruction in agriculture are largely lost from want of a class-room, where charts, models and selected specimens can be displayed to illustrate the subjects under discussion.

My large collection of stereopticon views of animal portraits and other objects, with a lantern for their exhibition, are of but little use in teaching, from the want of a suitable room in which they can be exhibited.

It is impossible to present to the student the detailed applications of the wide range of sciences relating to agriculture, in a form that will enable him to fully appreciate them, without the best possible facilities for illustrating the facts presented from so many sources.

MANLY MILES,
Professor of Agriculture.

REPORT OF J. W. CLARK,

FARM SUPERINTENDENT.

President JAMES C. GREENOUGH.

SIR: — I have the honor to submit my report of farm perations since April 1st, 1883. During the past year the farm was under the control of Mr. D. H. Tillson until April 1st, when it came under its present management. The plans for the season had been formed in part, so that little change was made in the general work of the farm; but from the first the aim has been to systematize the work so that it might be done with the least possible expense. In caring for the stock it has been insisted on that it should be done with regularity and by competent men, which shows a marked improvement in both the yield of milk and the condition of stock. A careful record of the number of pounds of milk given by each cow has been kept, and such as do not prove themselves profitable have been or will be disposed of just as soon as they do not pay for the food consumed; this being the only way that stock can be kept with profit. The boarding-house has been supplied with milk, and some sold to families living near the farm; the remainder has been set and the cream sent to Amherst Creamery, which is found more profitable than making butter on the farm.

The crops grown the past season have been: corn, twelve acres; potatoes, four acres; fodder corn, one acre; carrots, one and one-half acres; mangels, one acre; Swedish turnips, one-half acre; buckwheat, six acres; wheat, two and one-half acres; rye, ten acres. The corn was so injured by the frost that not more than half a crop of sound corn was har-

vested. The buck wheat also gave promise of a large yield, but was injured by the frost. The root crops were all good. The greater portion of the land on which the rye was sown was low and wet, causing much of it to be thrown out and killed by the frost, in consequence of which the crop was light. The hay crop was below that of previous years, owing to the dry weather preventing the second crop, and the practice of selling hay and grain when it should have been fed upon the farm and the number of the stock increased. The crops of the farm should be fully double what they are at present. The soil of the farm is particularly adapted to grass, and the farm might be made one of the best dairy farms in the State, if the right course was taken to reclaim the wastes of the pasture and break up and re-seed some of the worn-out pieces of mowing, giving them a liberal dressing of manure and draining where it is needed. This will of necessity require considerable outlay, but it will be money well invested. A private individual could not afford to let his land remain in the condition of many acres on this farm, neither can the State afford it, and the sooner every available acre is made to produce a full crop, the sooner will the farm become a credit to the State and a paying investment. A beginning has been made the past season. About fourteen acres of land in the pasture that was ploughed the year before, and left without anything being sown upon it, has been re-ploughed and sown to rye and grass-seed, to furnish pasturing where the past year was nothing but smartweed, positively worthless for feed. Besides this, some sixteen acres of the pasture grown up to alders, briers, etc., have been grubbed out and ploughed, a part of it for the first time. This, well-fitted, and sown to oats and grass-seed in the spring, will add fully thirty acres of feed to the pasture.

The stock of the farm consists of 27 head of Ayrshires, 3 grade cows, 2 yoke of steers, 1 yoke of cattle, 1 fine Guernsey bull, — a gift of Mr. W. A. Reed, of Hadley, Mass., — and 1 Ayrshire bull presented by Ben. P. Ware, of Marblehead, Mass.; 3 horses, 20 Berkshire swine, 3 medium Yorkshires and 1 grade hog, — all of which, with

the exception of the last mentioned, are pedigree animals,— and 75 fowls.

In taking the inventory of stock, I have put the value according to the worth of the animal, and what it would sell for if placed on the market. In this way the value of the stock can be compared from year to year, without the uncertainty of fancy prices, for these vary greatly different seasons, and also with different breeders, one selling an animal for $500 which another could not for $100. I include in this report the inventory of stock, hay, grain, etc., as I found it April 1st, giving credit for all stock since sold and the price received. To the value of the young stock I have added from $5 to $15 each, according to the growth and condition of the several animals. The increased value of the steers is the increase in weight, reckoned at five cents per pound. Comparing the value of live stock of April 1st, 1883, with that of Jan. 1st, 1884, a balance is found in favor of Jan. 1st, 1884. The value of the hay, grain, roots, etc., will vary little from what it was Jan. 1st, 1883. The tools and vehicles have been taken at the value given last year, they being fully as valuable as then. Besides doing the regular farm work, the roads have been kept in order, grading has been done about the Drill Hall and other college buildings, the grounds have been kept in order, the cellar dug for the president's house and the grounds about it graded. The team-work of the experiment station has been done, the crops harvested, grading about its buildings and construction of the road upon its grounds. Besides having charge of the farm, I have given instructions in agriculture to the freshmen class throughout the year, and also taken charge of class work.

The first great need of the farm is to settle upon some fixed plan for the future, to decide what branch of farming shall be carried on, and then to work for that, and not be shifting from one thing to another. The buildings and soil of the farm are adapted to stock farming, and money should be furnished with which to purchase fertilizers the coming spring, that more hay, grain and roots may be grown, that more stock may be kept, and in this way to improve the

farm by the increased amount of manure made; for the more stock kept, the more manure, and the more manure the greater will be the crops, and the larger the crops the more stock can be kept. The milk can be set and the cream taken every day by the Creamery Association, netting about $2\frac{1}{2}$ cents per quart for the milk set, and the skim-milk can be fed to swine and young stock; in this way returning nearly all of the valuable constituents of the food back to the farm, making it better and more productive each year.

Another need of the farm is suitable shed-room for the wagons and carts where it will be convenient, that all such property may be housed when not in actual use, and not be exposed to the weather as was the case the past summer. If the shed which now extends across the south side of the barn-yard were moved so as to form a continuation of the shed on the west side of the yard, a portion of it converted into a place for storing wagons, carts, etc., much space which is now of little use could be made valuable, and the barn-yard which is now nearly ruined by this shed, shutting out the sunshine, would be made comfortable during the winter months. One end of the shed should be made into a tenement for the help, and the farm be saved the expense of hiring a tenement for the men, off the farm. The Agricultural Department of the college needs more money than any other branch of the institution, to place it on a level with the other departments. It has always been compelled to take a secondary place in importance, but the time has come when it should rank second to none, and money should be given for a building, to be known as the Agricultural Hall, where different kinds of farm produce and implements can be brought together to be used for illustrations. The other departments of the institution have their collections to aid them in explaining or applying the subjects taught, and why not the agricultural? for a more useful and interesting collection could not be brought together than one composed of agricultural products and implements.

The farm account from April 1st, 1883, to Jan. 1st, 1884, without giving the farm credit for the improvement made in

the pasture, which cost at the lowest estimate $175, or credit for other improvements, stands as follows: —

Expenses from April 1st, 1883, to Jan. 1st, 1884,		$2,872 05
Cash received since April 1st,	$1,333 17	
Bills handed in " " "	1,067 96	
Bills due,	290 16	
Increased value of stock since April 1st,	177 25	
		2,868 54
		$3 51

Respectfully submitted,

J. W. CLARK.

REPORT OF THE BOTANIC DEPARTMENT.

J. C. GREENOUGH, *President.*

I have the honor to report the following upon the condition of the department under my charge.

Early in the year this department met with a great loss in the burning of the "Durfee Plant House" and the destruction of a large and very valuable collection of plants, including most of the stock for the propagation of bedding plants for the spring sales and for planting.

About 8 o'clock in the evening of January 23d, fire was discovered in the work-room, but it had gained such headway that nothing could save the main building. The students were soon on the grounds, and by the use of light snow, which was abundant, the two wings — the lily and stove rooms, and the propagating pits were saved, although the plants within them were very much injured. At this time the thermometer indicated 8° below 0°, and as soon as the flames were under control, stoves were procured, by which means, and covering the sides of the houses with mats the temperature within was kept above freezing until the boiler and pipes could be repaired, which was not until the afternoon of the 25th. The origin of the fire cannot be satisfactorily accounted for, but it undoubtedly started in a pile of wood not far from the large boiler.

The wings and the pits were at once temporarily repaired, and stock plants purchased for propagation for spring sales. The two most valuable plants in the collection, the sago and fan palms, were taken up as soon as possible the next morning, and although their tops were burned completely off, and they were exposed to extreme cold for more than twelve

hours they are now growing vigorously and in a few years will reach their original proportions.

During the summer and fall the parts of the building destroyed have been replaced by structures which are thought to be much more ornamental and are certainly more convenient and better adapted to the work of the department. The work-room which covers the furnace cellar is two stories high, the lower one being divided into two rooms, one for a reception or waiting and sales-room, and the other the work-room proper. In the second story two rooms have been fitted up for a study and sleeping-room, while the north half is devoted to the purposes of a tool and work room. The foundation of this building was raised one foot higher than that of the one destroyed, and by removing two or three large piers and rearranging the heating pipes, more space has been obtained, and the risk from fire very greatly reduced.

The sales of flowers and plants for the remainder of the winter and spring was much less than it would have been but for this accident.

Crops.

The crops, notwithstanding the drought, have been much better than last season. A detailed statement of the income is appended to this report.

Improvements.

Among the improvements made upon the grounds of the department are the draining of the land between the county road and the one leading by the Botanic Museum, and the springy side hill south-east from the plant houses. Nearly 2,000 feet of tile was laid in the most thorough manner in the former, and the land, which before scarcely produced hay enough to pay for cutting, planted with corn, cabbages, squashes and turnips. The crops upon this land were very satisfactory, and it is now in the best possible condition for almost any farm crop. The side-hill lot was underdrained with stone-drains, — the stones being gathered from the orchard and other land on the hill east from the plant house. The drains are working perfectly and the land produced a fine crop of squashes.

The hot-beds, which were located west of the propagating house, have been removed to a more sheltered location south of the same, and the land graded and seeded and the collection of some twenty-five varieties of Japanese maples planted in groups or singly. More than the usual amount of work has been done the past season in keeping the roads and walks in good condition and in the decoration of the grounds.

Wants.

One of the urgent needs of this department is a barn for keeping two horses, carriages, tools, etc., and for packing trees and shrubs during wet weather. A cellar is also needed for storing vegetables and fruit, and a portion of it for storing half-hardy trees and shrubs. The barn where the work horses and the heavy wagons and tools are now kept is fully occupied by them; the stable in the rear of the Botanic Museum will only accommodate one horse and hay enough to keep it for only three or four weeks, while the room is much needed for small tools of the department and for a work-room.

When the president of the college becomes located in his new house on the grounds, a stable will be needed to accommodate his horse and carriages also. These needs will require a building 40 by 60 feet, with 14 or 16 feet posts and a frost-proof cellar. For the construction of such a building timber for the frame can be easily and cheaply obtained from the chestnut grove near by, without injury to it, and pine lumber in large quantities is already on hand at the farm buildings.

Another urgent need is a complete set of gardening tools, independent of those used for the ordinary business of the department, which may always be on hand for illustration or educational purposes.

Sources of Income for 1884.

In addition to the same sources of income as the past season, we have about one acre of asparagus, one and one-half acres of raspberries and blackberries, and about three-fourths of an acre of currants, all two years from planting. Besides the above, we have about 25,000 more peach trees

for sale than last year, and a much larger general nursery stock, and the orders now in indicate a very much larger sale than ever before. The land under cultivation is in a much improved condition, and having been kept quite clear from weeds for the past three years, can be cultivated at less expense. Nearly all the land to be planted next spring has been ploughed, which will greatly assist in the work of the spring.

Financial Statement.

Cash Dr.

Cash on hand Jan. 1st, 1883,	$18 06
received for plants,	1,096 48
flowers,	338 74
vegetables,	1,001 14
trees and shrubs,	1,718 07
fruit,	573 98
sundries,	89 95
collected by Bursar,	450 29
income of Hills fund,	675 92
on hand Dec. 31st,	7 58
Total cash income,	$5,970 21

To the above should be added credits as follows: —

Outstanding bills,	350 65
Expense of draining side-hill lot	145 00
Expense of draining north lot,	215 00
Work upon roads, walks, etc.,	102 50
Planting trees along roadway,	20 00
Plants for decorating grounds of farm-house, etc.,	25 00
Increased value of produce on hand,	25 00
Increased value of grain,	35 00
Increased value of nursery stock,	1,000 00
Value of seeds on hand,	55 00
Total income,	$7,943 36

Cash Cr.

Total cash paid out,	6,822 39
Balance,	$1,120 97

S. T. MAYNARD.

APPENDIX.

List of Plants desired for Educational Purposes, to replace those Destroyed by Fire.

Illicium religiosum,
Bixa orel'ana, ... *Arnotta.*
Polygala Dalmaisiana,
Camellia Japonica, ... *Double and single.*
" sasanqua, ... *Varieties.*
Thea Bohea, ... *Black Tea.*
" veridis, ... *Green Tea.*
Hiptage mandablota,
Swietenia mahagoni, ... *Mahogany.*
Hibiscus splendens,
" sinensis,
Pistachia lentiscus, ... *Mastic tree.*
Acacia melanoxylon,
Indigo-fera tinctoria, ... *Indigo.*
" anil,
Tamarindus Indicus, ... *Tamarind.*
Myrtus communis, ... *Myrtle.*
Lagerstrœmia Indica, ... *Crape Myrtle.*
Eryngium eburnum,
Aralia papyrifera, ... *Paper aralia.*
Coffea Arabica, ... *Coffee.*
Posiqueria longiflora,
Montanoa hieracleifolia, ... *Tree Astor.*
Stylidium,
Azalea Indica, ... *Single and double var*
" Pontica,
Volckameria acauleata,
Cobea scandens variegata,
Stephanotus floribundus,
Olea sativa, ... *Olive.*
Mackaya bella,
Laurus camphora, ... *Camphor tree.*
" cinnamomum, ... *Cinnamon* "
Grevillea asplenifolia,
Piper nigra, ... *Black pepper.*
" betel, ... *Betel* "
" cubeba, ... *Cubeb* "
Stenocarpus Cunninghamii,

Manihot utilissima,	*Tapioca.*
Croton pictum,	
Artrocarpus Indicus,	*Bread-fruit.*
Ficus elasticus,	*India rubber.*
Siphonia elastica,	*Caoutchouc.*
Damara australis,	*Broad leaved pine.*
Cycas cercinalis,	*Sago cycad.*
Zamia tennifolia,	
Phœnix dactylifera,	*Date palm.*
Cocos nucifera,	*Cocoa-nut palm.*
Elaeis guineensis,	*Oil* "
Areca catechu,	*Betel* "
Sagus laevis,	*Sago* "
Caryota urens,	*Sugar* "
Ceroxylon audicolor,	*Wax* "
Phytelphus macrocarpa,	*Ivory* "
Calamus Rotang,	*Rattan* "
Zinziber officinalis,	*Ginger.*
Maranta arundinacea,	*Arrowroot.*
Testudinaria elephantipes,	
Diosperus ebenum,	*Ebony tree.*
Victoria regia,	*Amazon lily.*
Papyrus antiquorum,	*Paper papyrus.*
Nymphea cœrulea,	*Blue lily.*
Ouverandria fenestralis,	*Lace leaf.*
Dicksonia antartica,	*Tree fern.*
Alsophylla Australis,	*Tree fern, 6 ft. high.*
Platycerium grande,	*Stag-horn fern.*
Dendrobium nobile.	

CHEMICAL DEPARTMENT.

J. C Greenough, *President.*

The instructions in theoretical and practical chemistry during the past year have been given in conformity to the curriculum of the college. It has been the aim of the instructor to make the instructions as practical as time and circumstances admitted. The elements were treated with reference to their importance in science and art; and the illustrations were chosen with a design to promote the special object of the institution, — to prepare the student for the various branches of industry, and of agriculture in particular. The instructions in the lecture-room are followed by practical observations in the laboratory. The characteristics of the various elements, and their most important compounds are studied by chemical analysis. Mineral substances prominent in the sciences and arts, as well as in agriculture are carefully tested, and their constituents ascertained. As soon as the student has become familiar by personal observation with the general qualities of many of these compounds, is competent to recognize the more common elements in their various combinations, and comprehends the working of the chemical laws in mineral matter, he receives a course of instruction in organic chemistry. Lectures in chemistry, applied in the sciences and arts, and especially in agriculture, finish the course of instruction.

The following regular class instructions have been given during the past year: The Sophomore class has attended one term of lectures and recitations in elementary chemistry on metallic elements. The Junior class has received for two terms, instructions in analytical chemistry, on the modes of ascertaining the constituents of industrial products. The

Senior class has studied for one term the composition of ores, ashes, fertilizers, and soils.

Besides this regular class exercise, a considerable amount of work has been carried on by special students in chemistry, and by post-graduates of the college.

The rooms of the chemical department of the college which have been spacious enough during past years, will be insufficient to meet the demands of incoming larger classes, and of the experiment station.

As it will be impossible to accommodate satisfactorily both institutions a year hence, it seems most desirable that action should be taken soon, to meet the growing wants of the chemical department of the college in regard to additional rooms and permanent assistance.

C. A. GOESSMANN.

EXPERIMENTS

Carried on at the Massachusetts Agricultural College since 1870.

The growing of sugar-beets, the manufacture of sugar from them, and trials of their value for cattle foods. This industry is soon to grow up in our midst, and to absorb large amounts of capital.

The sources of supply, and the quantity and quality of our manurial agents. These careful scientific investigations have been the prime means of revolutionizing the manufacture and trade in fertilizers, not only in this State, but throughout the country.

Laboratory and physical examinations of the South Carolina phosphates, and trials of their agricultural value in the raw state, and after treatment with acids.

On the use and effect of common salt on grain and root crops.

The chemical and physical condition of the salt marshes of the State, and the devising of methods by which they can be made available for agricultural purposes.

Experiments with compound commercial fertilizers, to test their comparative agricultural value, and their value as compared with single elements.

To determine what elements will make practically a complete manure, on our average soils.

Investigations of the quality and composition of commercial fertilizers offered for sale, and the protection of the community by legal control and inspection from frauds in them.

Observations and study of the phenomena of plant-life.

The circulation of sap in plants, and their expansive power during growth.

To determine the proportions of different elements of nutrition in feeding substances to be used to save needless expense, and to produce the most certain results.

Experiments on the continuous growth of crops, on the same soil, with chemical fertilizers alone.

The influence of different kinds of fodder-plants fed to milch cows on the quality and quantity of their milk and butter.

Contribution to the chemistry of American wild and cultivated varieties of grape-vines.

Investigations of dairy products, — oleo-margarine, Jersey, and skim-milk cheese.

Examinations of animal secretions; variety of urinary calculi, etc.

Examinations of various vegetables and fruits.

Examinations of varieties of sugar-beets raised throughout the State of New York, Lower Canada, and the Connecticut River Valley.

Investigations concerning the saccharine qualities of several varieties of corn and melons.

Examinations and trials to test the comparative value of different methods of setting and treating milk in the butter dairy.

Practical trials of new implements, and a great variety of farm machinery.

Investigations as to the effect of girdling fruit-trees and plants to hasten the time of ripening, and to improve the quality of the fruits.

The effect of chemical salts on the carbo-hydrate contents of plants, and the quality of the fruits.

The construction and repair of common roads.

The growing of early amber cane, and the manufacture of sugar from its juice.

The influence of temperature, and the vital functions of plants, and temperature of soils and air, on the changes in form of water in soils, and plants and vapor in air.

Investigations in relation to the evaporation and percolation of water from the soil.

The tilling of soils of different characteristics, as affecting the loss of water by evaporation.

The determination of the elements of plant nutrition lost from the soil by leaching, and of those it retains.

Investigations in relation to the comparative temperature of the soil and air by day and by night.

The establishment of true meridian lines, to regulate the practice of surveying.

The comparative study of milk of different breeds of cows.

Accurate investigations of the comparative nutritive and feeding value of Northern, Southern and Western varieties of Indian corn.

Experiments regarding diseased peach trees, yellows, etc.

Experiments regarding the influence of special manures on fruits, etc.

MATHEMATICS AND PHYSICS.

The work of the mathematical department during the past year had been conducted upon the plan indicated in the last annual report. The only variation in the amount or order of work indicated in that schedule was the substitution of nine hours instead of five hours for instruction in surveying during the third term. Much of this time was occupied in actual field practice, making surveys by various methods, and plotting and calculating areas from the notes. The revised course increases slightly the time devoted to mathematical studies, but the changes are so immaterial that the schedule presented in the present report may be referred to for an outline of the work of this department during the past as well as the present year.

Some obstacles to satisfactory work in this department still present themselves. Although the average scholarship of the present freshman class is creditable, and in the case of a few individuals very gratifying, there is a greater diversity of ability and attainment than is noticeable in institutions whose students have all been subjected to a somewhat uniform course of preparatory training. As a result, there is difficulty in allotting work sufficiently rigid to properly occupy the better trained members of the class, which shall not overburden and discourage the less forward ones. This evil manifests itself especially in the study of algebra. The progress of the class during the past term has therefore been retarded by the necessity of an effort to bring the poorly trained students into line. It is impossible to entirely obviate this difficulty by increasing the requirements for admission. The remedy lies in the hands of the teachers of high schools throughout the State, upon whom

rests the responsibility of giving a thorough drill in the principles and operations of elementary algebra to all young men anticipating membership in this college.

Another obstacle is the deficiency in the apparatus for illustrating sound, heat and light, branches of science which especially require demonstration to the senses. An adequate enlargement of the physical cabinet is certainly one of the most stringent needs of the institution.

The mathematics comprise the chief disciplinary studies of the course; therefore my first aim is to develop in the students the mental habit of exactness, not only indispensable for mastery of the pure mathematics, but the first requisite for successful pursuit of all branches of science. My second aim is to introduce such exercises as will stimulate ingenuity and originality. My third aim is to give a practical bearing to all studies, by means of experiment and illustration drawn from familiar fields of observation.

The trustees and other friends of the institution will be very welcome at the class exercises of the mathematical department. Such manifestation of interest would gratify and stimulate both students and instructor.

AUSTIN B. BASSETT.

DEPARTMENT OF ENGLISH AND THE MODERN LANGUAGES.

President JAMES C. GREENOUGH.

SIR: — I have the honor to submit the following report of the department of modern languages and English literature.

The course as now established does not differ materially from that of preceding years. Its most essential feature is the making optional the study of French and German. The change in the time of commencing these studies, making them coincide with the opening of the college year, cannot fail to be of practical advantage to the student, allowing him three consecutive terms of work without the intervening of the long summer vacation. The method of instruction pursued has been the same in both languages, the object being to secure fluency and ease in translation rather than to make finished scholars. To this end the first term has been devoted to mastering the general principles of grammar, the rules for pronunciation, and the reading of some light, easy work. In the second term, more advanced translation has been attempted, usually from some standard author in fiction or history; while in the third, the selection has been made of a scientific work, which should combine practice in translation with information in some one of the various departments of agriculture. In this way have been read, among other books: Puys — Plants under Glass; Marion — Wonders of Vegetation; Vaulx — What Constitutes a Dairy; Schleiden — Plant-Life; Prosch — Breeding and Care of Cattle; Peschel — Physical Geography.

The instruction in English literature has been partly oral

and partly by the study of a text-book. A series of lectures on the great race epochs of English history opened the course, and the text-book has been supplemented by lectures at the close of each literary period. English history and English literature have been, as far as practicable, taught together, and it has been the constant aim to make the one the complement of the other.

MILITARY DEPARTMENT.

James C. Greenough,

President of the Massachusetts Agricultural College.

Sir: — I have the honor to submit the following brief report, and to append the theoretical and practical course of the military department, with the names and grades of those holding official places in the present battalion organization.

It is a pleasure to note a general improvement in all which pertains to this department. A building enclosing recitation-room, office, armory and an ample drill-hall has finally been completed. Its tasteful design adds much to the appearance of the grounds, and it at once embodies and supplies the needs which have been particularly apparent in winter, a season which inclines the student to the least exercise. Much of the old regalia, as hats, plumes, sashes, has been replaced by new. A small but growing military library, thoroughly interesting to all, has been established. A few samples of powder, shells, fuzes, etc., form the basis of a museum which, improved, will materially aid in giving the student proper ideas of Ordnance. The interest, discipline and information of the students are constantly improving, and the present assurance of larger classes is the sure precursor of still greater advancement. In considering the scope of this department, the plan thus far followed has been to take a middle course in discipline and instruction between a distinctly military institution like our National Academy, and the ordinary literary college. Due recognition is given to the claims of the United States, its purpose in founding this and similar colleges, — and to the fact that the student after graduation is not identified with, dependent upon or especially aided by the government. The tactical instruc-

tion has therefore been confined to the time devoted by the best colleges to calisthenics. The student acquires with his physical exercise what will be of mutual profit to his country and himself in case of need. Should our volunteer soldiery be called into active service, the average graduate of this college could not fail to secure an honorable position at once. The varied drills, mainly in the open air, besides exercising every part of the body, and under the most favorable circumstances, for health, — have a purpose beyond the development of the mere physical man. The student must use his reason, his voice, his body. He must control himself as well as others. The artillery, mortar, company, skirmish and battalion drills have each their different commands, different formations and distinctive objects. They are alike only in requiring exact discipline, quick and implicit obedience from the instructed; from the instructors, — usually seniors, — a comprehension of their purposes and a capacity to control and command obedience from others. To be straightened into "the position of the soldier," *once*, is to be benefited; and no estimate can be made of the good derived by those who even reluctantly are brought to a regular methodical course of drills for four years. These matters are not sufficiently considered when boys are sent away from their homes for an advanced education. The weekly inspection of the dormitories, and the daily inspection at all drills, are calculated to remedy the careless tendencies of students by the enforcement of personal neatness, which is the basis of a proper, healthful and instructed life. Tactical studies are taken in regular course, but not to exceed one hour per week during the first term of each school year for each of the junior classes. The time thus employed, as it is distributed is scarcely missed, and more perfectly practical instruction is thus permitted. The studies pursued by the seniors, amounting to two hours each week through the year, alone take appreciable time from the students. They are arranged to include the elements of fortifications and ordnance, especially useful in war, — a brief survey of constitional and military law, and much important history, by the review of prominent campaigns of ancient and modern times. It is not desired to give exact information concerning

marches, camping, field fortifications, and such other matters as would be of especial importance to field and company officers in the service; but rather to excite some taste for the future reading of military works, than to go into the reasons for intricate strategic movements. It is hoped that the State or general government will respond to a demand for a second platoon of field pieces, which the increasing numbers in the lower classes will soon require. It is proposed, commencing with the next school year, for obtaining more perfect quiet in the dormitories during study hours, to place cadet officers, under proper regulations, in control of the different entries. The best results are anticipated where interest and the confidence reposed, combine to urge a strict compliance with the requirements. I take this opportunity of urging that a more intimate connection be recommended to His Excellency the Governor, between this corps as an organization and the State militia. Massachusetts takes much merited pride in her present organization, and a wisdom among legislators and officials which recognizes the necessity of having an experienced body of State troops ever ready, — must see the desirability of giving the students of the *State College*, where military duties are an essential feature, an opportunity for a few weeks camp life, yearly. It seems practical that this corps should be placed on the same footing with regimental organizations of the State, transported to Framingham, and paid at the same rates as the same grades in the militia. Two weeks yearly in camp, at a convenient time in the summer, would be of the greatest advantage. The few hundreds thus expended would be an economical outlay, and some additional interest might be excited in the State college, and in the students who seek an education there which prepares them at once to be intelligent men in peace and valuable soldiers in war.

Very respectfully,

Your obedient servant,

VICTOR A. BRIDGMAN,
1st Lieut. 2d U. S. Artillery,
Prof. of Military Science and Tactics.

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